Iron AND Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

ATTEND THE IRON & STEEL EXPOSITION

TECHNOLOGY DEPT.

JULY, 1958

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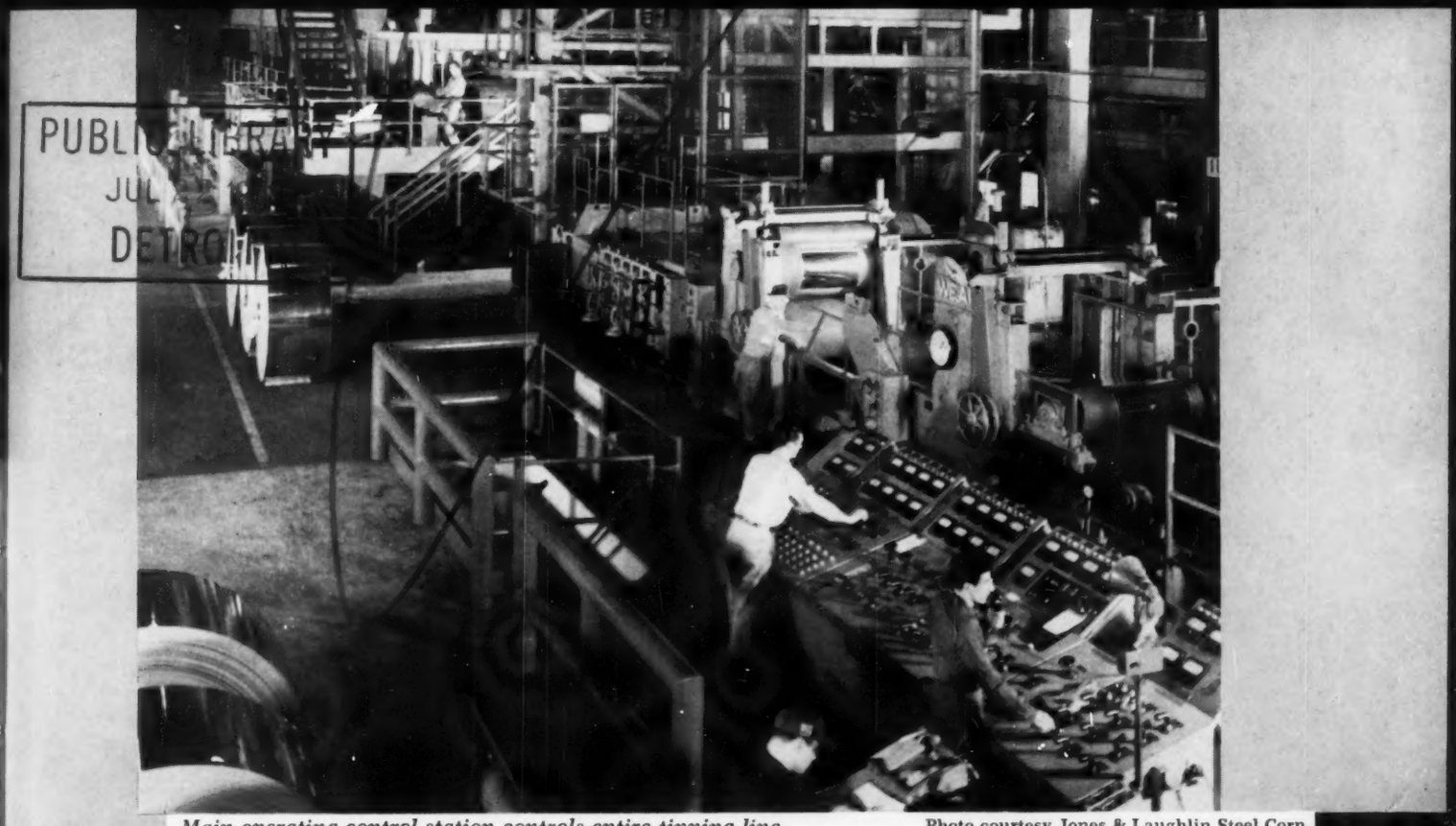
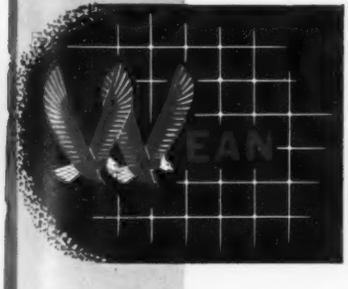
Faster, better tinplate production through

WEAN creative engineering



Main operating control station controls entire tinning line. Photo courtesy Jones & Laughlin Steel Corp.



339A

• 75% of all electrolytic tin plate is produced on Wean engineered lines . . . and for a very good reason. Wean, a pioneer in continuous coating lines, has played a major role in bringing tin plate production equipment to its present high degree of efficiency.

Some time ago, for example, Wean adapted automation to tin plate production—enabling lines to produce continuously—establishing records both for speed of production and quality of product; in short, enabling tin plate producers to keep abreast of modern industrial demands.

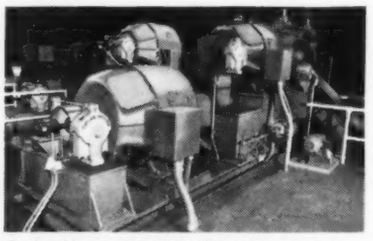
So, if you're looking for tin plate facilities to meet today's exacting requirements . . . look to Wean, world's foremost designer of electrolytic cleaning and tin plate equipment.

THE WEAN ENGINEERING COMPANY INC., WARREN, O.

The Cutler-Hammer engineered D-c adjustable voltage control system provides precise, dependable speed control of the continuous steel ribbon from entry to exit in the world's fastest cleaning and annealing line.

Cutler-Hammer operator's control station at the entry end of the line.

Cutler-Hammer Unitrol provides a convenient, space-saving unit for all A-c auxiliary controls.



Cutler-Hammer 505 Mill Brakes are used on the winding reels and bridle stands.

Cutler-Hammer operator's control station at the exit end of the line.

Behind the scenes at Weirton Steel...

Cutler-Hammer Control keeps the world's fastest continuous cleaning and annealing line on the go

The new continuous strip steel cleaning and annealing line at the Weirton Steel Company division of National Steel Corporation is truly a remarkable engineering achievement. It automatically cleans and anneals an endless ribbon of cold rolled steel at speeds up to 2,000 feet per minute . . . a new world's record. But of equal importance is the fact it can deliver 20,000 tons of steel ready for tin plating every month.

Unquestionably, a processing line such as this represents a major capital investment which must pay for itself through high speed, dependable production day after day . . . month after month . . . year after year. And to a great extent its successful operation depends upon the trouble-free performance of the control equipment which integrates and regulates the complex system of individual machines that go to make up the line. Here Cutler-Hammer's 65 years of control engineering experience provided the expert "know-how" in designing the *right* control system, the *dependable* control system for this performance champion.

You too will find it pays to work with Cutler-Hammer for the practical solution to all your control problems involving mill machines and processes. CUTLER-HAMMER Inc. 1269 St. Paul Ave., Milwaukee 1, Wis.

CUTLER·HAMMER
CONTROL
C-H

LOOK TO CUTLER-HAMMER MILL EXPERIENCE...AS BROAD AS IT IS LONG

Cutler-Hammer Inc., Milwaukee, Wis. *Division:* **Airborne Instruments Laboratory.** *Foreign:* **Cutler-Hammer International, C. A.**

Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.; Intercontinental Electronics Corporation, Inc.

IRON AND STEEL ENGINEER; published monthly by Association of Iron and Steel Engineers at 20th and Northampton Sts., Easton, Pa. Editorial and advertising offices, 1010 Empire Bldg., Pittsburgh 22, Pa. Entered as second class matter at Easton, Pa.

Here the Multi-Strand is producing three 3⅛" O.D. x .350 copper tubes down to 1½" O.D. x .080.
The machine can be used for copper, brass, aluminum or steel tubes.

MULTI-STRAND COLD TUBE ROLLING MILL

"Great Advancement for Economical Production of Small Diameter Tubing"

This is a breakdown process — producing a copper tube 1½" O.D. direct from a pierced or extruded shell 3 inches in diameter.

The production, considering the heavy reduction of 90%, is equivalent to five cold draw passes and the full production of two triple drawbenches (one 150,000 lbs., one 100,000 lbs.). The rolling method eliminates pointing of tubes, sawing and crane handling. The tubes, without annealing, can go directly to a Bull Block or Drawbench for final reduction.

This revolutionary method, developed by Aetna-Standard, results in a new economical way of producing small diameter tubing. The initial installation is producing tubes in quantity beyond original expectations.

- Much less handling.
- Heavy reductions on three tubes at a time.
- A ten-to-one elongation.
- Saves man-hours, floor space and tube handling.

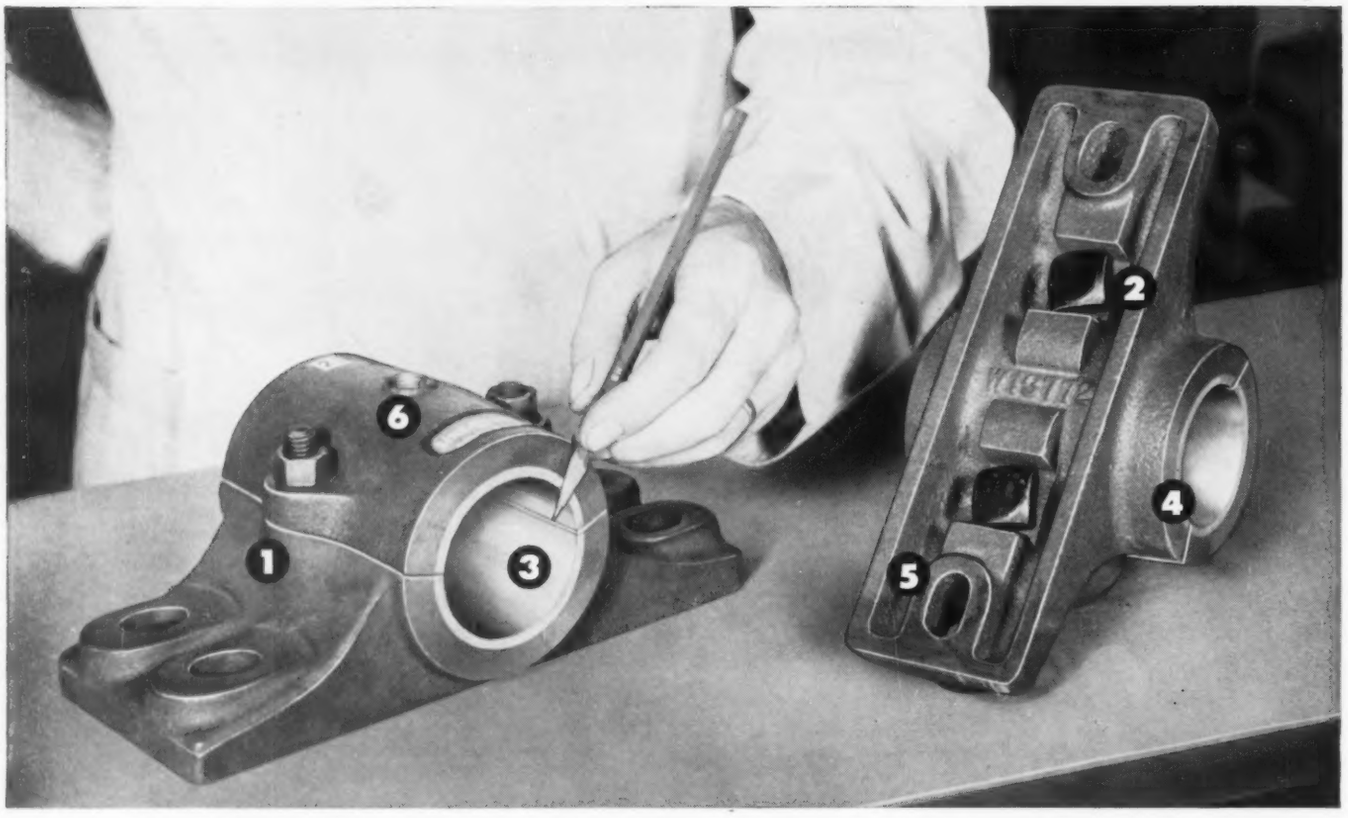
AETNA • STANDARD

THE AETNA - STANDARD ENGINEERING COMPANY

GENERAL OFFICES: PITTSBURGH, PA. • PLANTS: ELLWOOD CITY, PA., WARREN, OHIO • RESEARCH LABORATORY: AKRON, OHIO

CONTINUOUS GALVANIZING LINES • CONTINUOUS ANNEALING LINES • CONTINUOUS ELECTROLYTIC TINNING LINES • SIDE TRIMMING AND SHEAR LINES AND OTHER FINISHING EQUIPMENT • CONTINUOUS BUTT WELD PIPE MILLS • SEAMLESS TUBE MILLS • DRAWBENCHES AND OTHER COLD DRAW EQUIPMENT • ROLLS AND CASTINGS • EXTRUDERS, MILLS, PRESSES FOR RUBBER, PLASTIC AND CHEMICAL

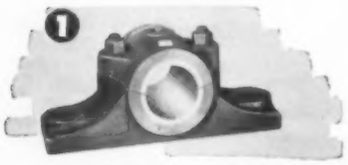
Make this revealing
6-spot check
on babbitted and bronze bearing quality



LINK-BELT offers efficiency-proved features in a complete range of types and sizes

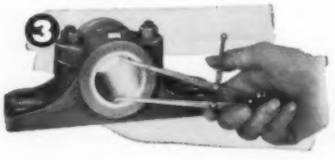
BEFORE you buy babbitted and bronze bearings, look for the features below. They're standard with Link-Belt—a complete range of more than 15 types and over 300 sizes of solid, split, gibbed or angle blocks. In addition, Link-Belt's broad distribution assures off-the-shelf delivery on sizes for ½- to 8-inch shafts, plus a wide variety of take-ups to meet any requirement. And for special applications, bearings can be furnished with cast steel housings.

Each bearing incorporates a heavy-duty babbitt or high-quality bronze. Careful packing provides protection during shipment — decals identify each by serial number and size for re-ordering. See your nearest stock-carrying factory branch store or distributor.



HOUSINGS are of durable cast gray iron . . . compact, exceptionally strong and rigid. No excess weight.

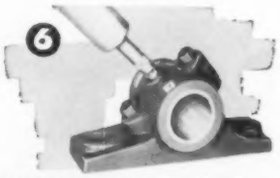
BASES are finished for close tolerance from base to center of bore—assure firm seating on supports.



BORES are finish-machined to close tolerances . . . assure concentricity, accurate fit on the shaft.

ENDS are finished to provide accurate bearing surface for collar or sprocket . . . reduce friction.

BOLT HOLES in base are slotted for easy adjustments and accurate shaft alignment.



LUBRICATION of bearing is provided through grooves and fitting in cap.

LINK-BELT

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Even the smallest-size Heroults have big electric furnace features!

Now, while you've got time to catch your breath, is a good time to take a searching look at your foundry facilities. In the face of the obviously keener competitive period ahead, wouldn't you be smart to modernize your melting equipment—to switch to electric furnaces—and be ready for the business upturn that's coming? *You can install a Heroult now with minimum inconvenience to plant operations.*

The Heroult Electric Furnace helps you produce better-quality steel . . . faster . . . and more economically

Available in standard sizes of shell diameter ranging from 7′0″ on up, and with capacities of from 1½ tons up to 200 tons, the improved Heroult is unquestionably the finest electric melting furnace on the market. The features listed below are found in all standard Heroult's—even the smallest.

The Heroult Furnace is 100% mechanically operated.

It includes such mechanical features as: heavy rack-and-pinion-type tilting mechanism; mechanical roof lift; motor-driven, rotating, jib-type roof swing; winch-operated, water-cooled jib-type door-lifting mechanism; and high-speed, electro-mechanical electrode-positioning mechanism.

Another exclusive—cage-type shell construction with shell plates clipped to a heavy supporting structure. This construction minimizes shell warping and allows easy replacement if shell plates are damaged.

Exclusive—Operating Mechanism Independently Supported.

The tilting platform on which all operating mechanisms are supported is attached directly to the rockers independent of the shell structure. Thus operating mechanisms are unaffected by any shell distortion.

Exclusive—Flat-Bottom Shell.

This feature facilitates easy shell relining and provides maximum protection against burnouts. Thicker refractory at the sides of the hearth promotes more uniform bath temperature.

Exclusive—Water-Cooled, Skew-Back Roof Ring.

This feature eliminates the need for special skew-shaped roof refractories.

Electrode Mast Safety Device.

This spring-loaded, rack-and-pawl-type device provides positive protection against damage resulting from electrode-winch cable breakage.

Square-Sectioned, Water-Cooled Electrode Mast Arms.

This design guarantees a rigid connection between mast and mast arm, thus helping to maintain proper electrode position and alignment.

Remote-Controlled Electrode Clamps.

This device, of the spring-clamp, air-release type, is located inside of the rear section of the water-cooled mast arm where heat cannot affect it.

Square-Sectioned Electrode Mast.

This design feature, developed by American Bridge, assures proper guiding and electrode positioning.

Rockers.

The heavy fabricated steel curved top and bottom rockers minimize forward travel during tilting. The furnace will return to charge position from any degree of tilt due to designed center of gravity.

American Bridge Division of USS TRADEMARK United States Steel

General Offices: 525 William Penn Place, Pittsburgh, Pa. • Contracting Offices in: New York, Philadelphia, Chicago, San Francisco, and other principal cities.
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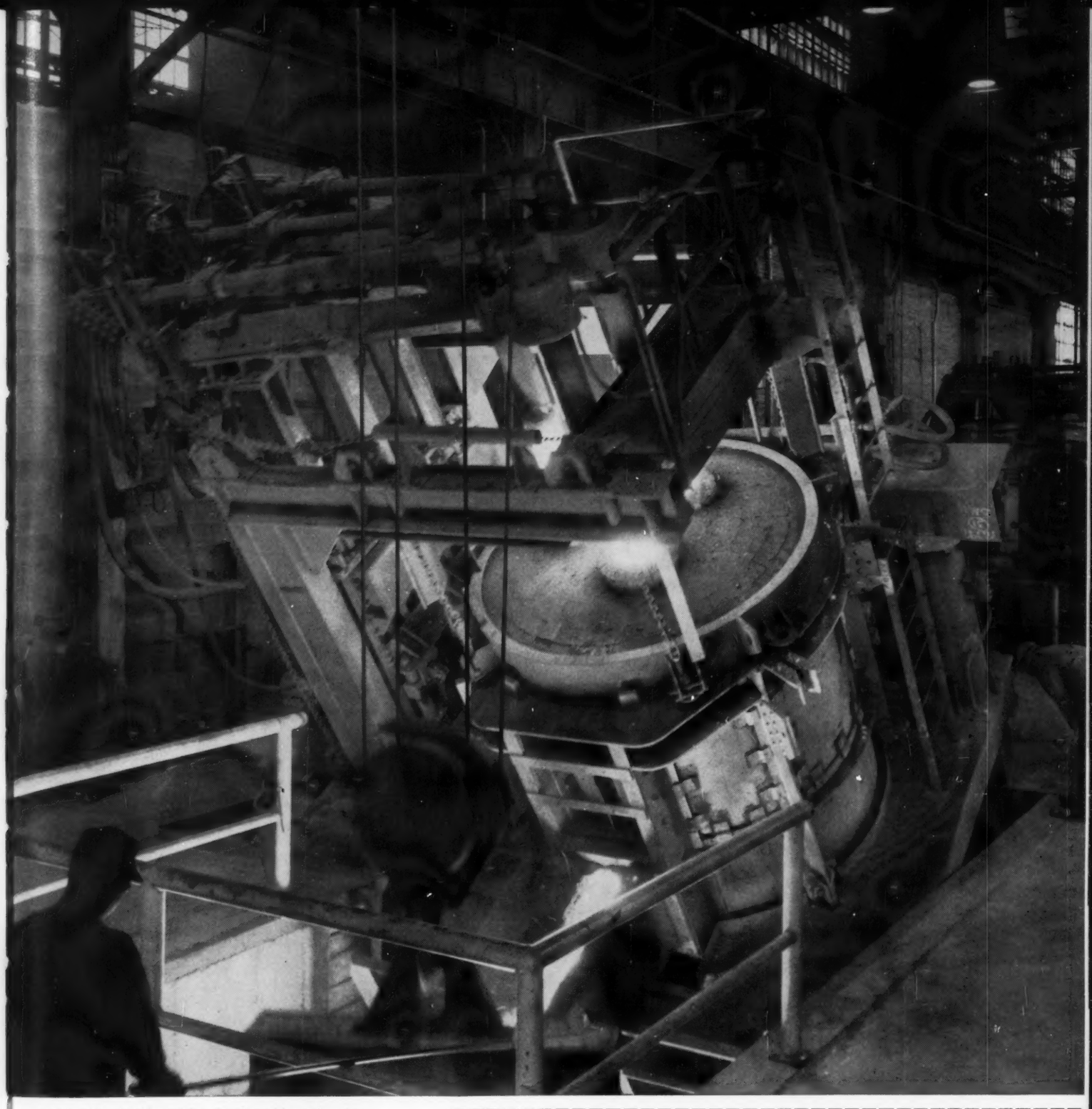

7′ dia., 1½-ton Heroult in a leading midwest foundry.

Should You Put in an Electric?
Our 32-Page Catalog
Tells You Where and When!

Send for our free Heroult catalog for comprehensive information on the advantages of electric melting. Contains charts and tables; gives sizes, capacities, and ratings. Helps you determine how the Heroult can improve your operation. Just contact the nearest office or write direct to Pittsburgh.

American Bridge Division
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Pittsburgh 30, Pa.

Please send me a copy of the latest Heroult Electric Furnace catalog ☐ and/or folder showing large drawing with special installation and engineering data ☐.

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FROM WRAPPER TO CORE...

Lee Wilson assures you absolute uniformity

Because Lee Wilson has developed methods for getting the heat to the coil faster, the entire coil reaches annealing temperature more quickly. Inner wrappings of the coil thus get the same amount of heat for the same period of time as the outermost wrappings. This means that every foot of every coil has been subjected to the same condition. What's more, Lee Wilson engineers have developed a simplified remote control that makes sure the heat is directed to the correct areas every moment of the annealing period, without periodic manual furnace adjustment.

Uniformity is necessary to good annealing. If you're concerned with the quality of your product, why not talk with Lee Wilson engineers soon?

Lee Wilson* ENGINEERING COMPANY, INC.

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HIGH PRODUCTION ANNEALING SYSTEMS

MAKE THE BEST METALS BETTER

* ORIGINATORS AND LEADING PRODUCERS OF OPENED COIL AND SINGLE STACK FURNACES

On this 5 stand mill with 10 spindles in operation, couplings have operated continuously for two years, with no spindle changes required.

MILLIONS OF TONS OF QUALITY STEEL PRODUCED BY AJAX-EQUIPPED MILLS

● Sensational records in output, product quality, and maintenance cost reductions have been made possible by AJAX Dihedral Spindle Couplings. Producers have established new standards of finish and gauge uniformity at speeds exceeding a mile a minute.

Their ability to maintain constant peripheral speeds while handling various angular and/or offset alignment requirements is responsible for better surface finish and longer roll life between grinds.

Freedom from backlash is resulting in smooth operation at speeds as HIGH AS 7200 FEET PER MINUTE. Twelve sizes are adaptable for original equipment as well as modernization of existing mills. They are delivering radically improved performance on heavy-duty hot mills, high-speed strip mills, package mills producing shim stock and foil, stretch reducing mills, straighteners, slitters, and other equipment.

As practically every AJAX Dihedral Spindle Coupling is built to special order, take advantage of our broad experience by writing the AJAX Engineering Department or call your local AJAX Field Representative.

AJAX FLEXIBLE COUPLING CO. INC.
WESTFIELD, N. Y.

REPRESENTATIVES IN PRINCIPAL CITIES

From one source . . . any instrumentation you need

When it comes to measurement and control, every industrial process is different. Each demands its own combination of accuracy, economy, instrument ranges and all the numerous other characteristics that are peculiar to the individual application.

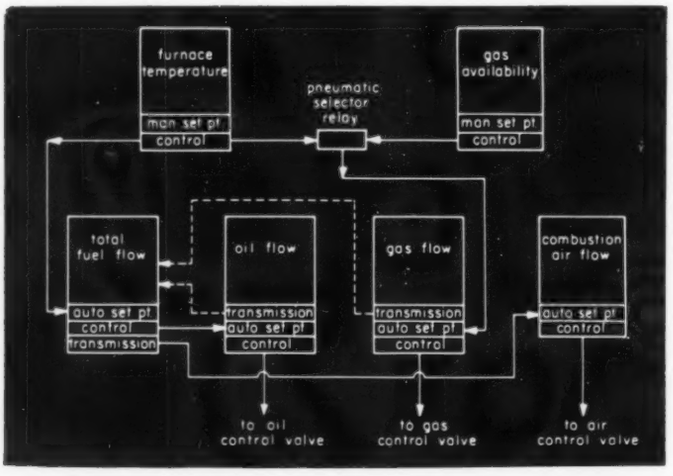
No single instrument and its accessories could possibly fit every process. So Honeywell makes a broad variety of measuring and controlling equipment that spreads across a tremendous range of applications.

The advantages are two-fold. First, you can get all the instrumentation your process requires from a single source, so there is undivided responsibility for the complete installation. And second, you are assured that the equipment selected for your process is recommended without bias . . . neither over-sells nor under-equips . . . needs no stretching, squeezing or compromising to fit it to its assignment.

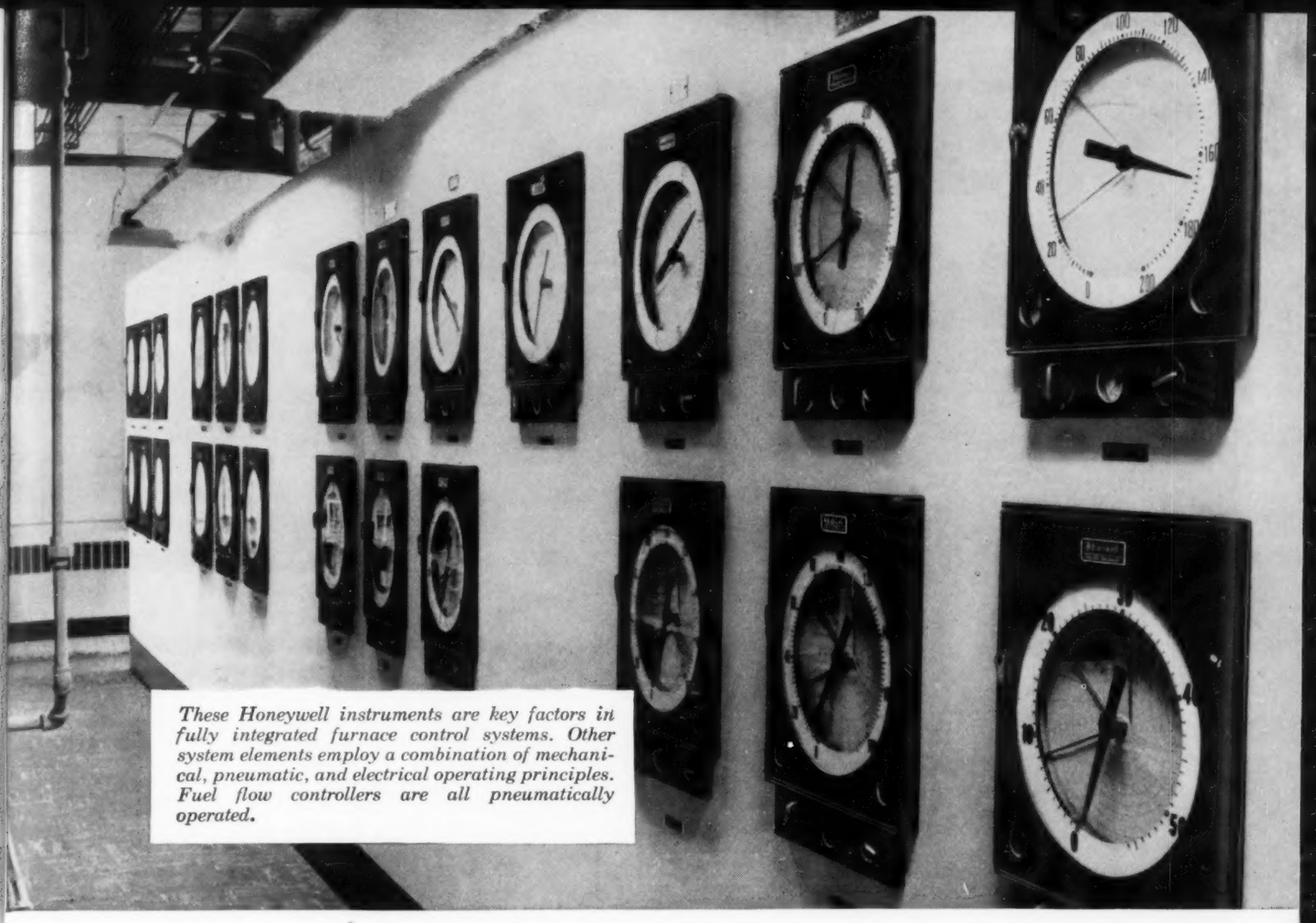
This versatile family includes *ElectroniK* indicators, recorders and controllers in circular and strip chart models, applicable to temperature, pressure, pH, power and dozens of other variables; square root flow meters for control applications; evenly graduated flow meters for cost accounting; thermometers, pressure gages and liquid level meters; *Pyr-O-Vane* millivoltmeter controllers. Especially useful for graphic panels are the *Tel-O-Set* miniature indicators, recorders and controllers. Electric and pneumatic control systems range from the simplest to the most complex, including automatic program controls and complete systems developed for particular processes.

Working with these instruments is a full choice of primary elements . . . thermocouples, *Radiamatic* radiation elements, pressure-type and electrical resistance thermal systems, flow meter bodies, pH cells and many others. For final control elements, you can choose from a wide range of electric motorized and diaphragm operated valves. To complete the picture, there are more than 7000 non-indicating devices for controlling temperature, pressure, vacuum, liquid level and humidity . . . an unmatched variety of instrumentation made by the world's largest manufacturer of control equipment.

Honeywell-engineered reheating furnace control system . . .



Control system for triple-fired, three-zone slab reheating furnace.



These Honeywell instruments are key factors in fully integrated furnace control systems. Other system elements employ a combination of mechanical, pneumatic, and electrical operating principles. Fuel flow controllers are all pneumatically operated.

puts byproduct gas to work

A large Eastern steel mill was faced with the problem of how to economically use its large quantities of byproduct gas fuels. A Honeywell-engineered control system provided the economical solution. The system puts byproduct gas fuel to work on the basis of its availability, automatically adjusting the combustion system as required. It adds the right amount of oil fuel to gas to make up the total fuel demand. And it maintains correct fuel-air ratios, automatically, under all firing conditions.

Manual control of furnaces was exceedingly difficult for two reasons. First, much of the gas was fed to multiple-fuel reheating furnaces, and surplus gas often varied widely and rapidly in availability. And second, fuel oil was used to make up the difference between furnace fuel demand and available byproduct gas fuel. Simultaneous balancing of the quantity of each fuel was needed to satisfy temperature and load demands of reheating furnaces.

Time that used to be spent coping with fuel problems now is concentrated on furnace operation and product quality. Personnel training and trouble-shooting have been simplified by the use of instruments of familiar design and construction. Maintenance of the complete interlocked control system, even in this steel mill environment, is no greater than that required for single instruments.

In your own plant, instrumentation by Honeywell can lead directly to important economies and upgraded product quality. Your nearby Honeywell sales engineer can give you the facts and figures . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

H HONEYWELL

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

First in Controls

CLEVELAND
15 TON CRANE 14115
Cleveland Cranes
FOR
STEEL MILL SERVICE
CLEVELAND CRANES
MODERN ALL-WELDED STEEL MILL CRANES
5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

△ In the midst of all the calamity howlers, it's refreshing to find an attitude like United States Steel's, as expressed by chairman Roger M. Blough in announcing issuance of $300,000,000 of 25-year sinking fund debentures:

"We believe that the greatest contribution that United States Steel can make at this time, not only to the national economy but to its customers, its employees and its shareowners, is to proceed with its current program of capital expenditures without any unnecessary curtailment or delay.

"By going ahead in this period of slack operations with a minimum of interference to production schedules, the company should benefit from substantial cost savings; while the national economy will benefit from a billion dollar program that, directly and indirectly, will provide jobs for many thousands of people."

△ Somehow, with the advent of these chemise, balloon and trapeze dresses, it's easier to look a woman in the eye.

△ A story date-lined Tacoma, Wash., July 5, stated "the large majority of the steel manufacturers of America. . .have undertaken to abolish the 12-hour day in the American steel industry at the earliest moment that the additional labor required shall be available."

Honestly, we haven't been hitting the pipe, but we did run across an issue of the Pittsburgh Post for July 6, 1923. The announcement was made by President Warren G. Harding, who said "the pledge of the steel manufacturers would be welcomed by our people as a whole and would be received as a great boon by American workers."

The letter to President Harding was signed (as far as we can decipher) by Elbert H. Gary, John A. Topping, W. A. Rogers, W. H. Donner, W. J. Filbert, E. A. S. Clark, James A. Farrell, E. G. Grace, James A. Burden, J. A. Campbell, A. C. Dinkey, C. M. Schwab, and several others.

The same paper carried a story to the effect that the Leviathan was "making a 23-knot clip on its maiden voyage."

△ In spite of all the complaints about imports of steel into the United States, figures released by the American Iron and Steel Institute put 1957 imports of steel at 1,153,702 tons, 16 per cent less than in 1956, while our exports of steel were 5,176,289 tons, 25 per cent more than in 1956.

△ From a bulletin put out by Macalester College:

"The American people do not want inflation and have the right to demand that those who hold to policies which cause inflation should change those policies.

"We could hold wages constant so that as productivity rises all groups share in the gains of rising productivity by all being able to buy more.

"In the opposite direction if we increase wages in the industries with powerful unions by amounts equal to the maximum rise in productivity in those industries, other unions will demand like wage increases which will be above their increases in productivity. This sends total incomes up faster than total productivity increases. This is an inflationary wage policy.

"Increasing wages therefore must be limited to the pace of increasing national average productivity.

"This rate of increase over the long run has been about 2.3 per cent a year. This has also been about the rate of increase since 1953. If a little pressure upon managements is wanted at all times, we could hope for wage increases limited to about 2½ per cent a year. This will double wages without inflation in 28 years."

△ A correspondent complains that, although the purchase of automatic gadgets for housekeeping has enabled them to dispense with a maid, a repair handy-man has become an absolute necessity.

△ After sitting in many meetings of various kinds held by various organizations over the years, we can't help but comment on the lack of consideration and courtesy evinced by too many individuals in strolling about during meetings and holding private conversations. Sometimes, salesmen apparently seize the opportunity to greet customers and give them the "pitch."

This practice embarrasses the speaker and annoys the audience. Certainly every meeting provides ample opportunity for such activity without disrupting the organized sessions.

△ We may not exactly have a laureate in our midst but this seems like sound advice:

My lady, be wary of Cupid
And heed to the lines of this verse—
To let a fool kiss you is stupid;
To let a kiss fool you is worse.

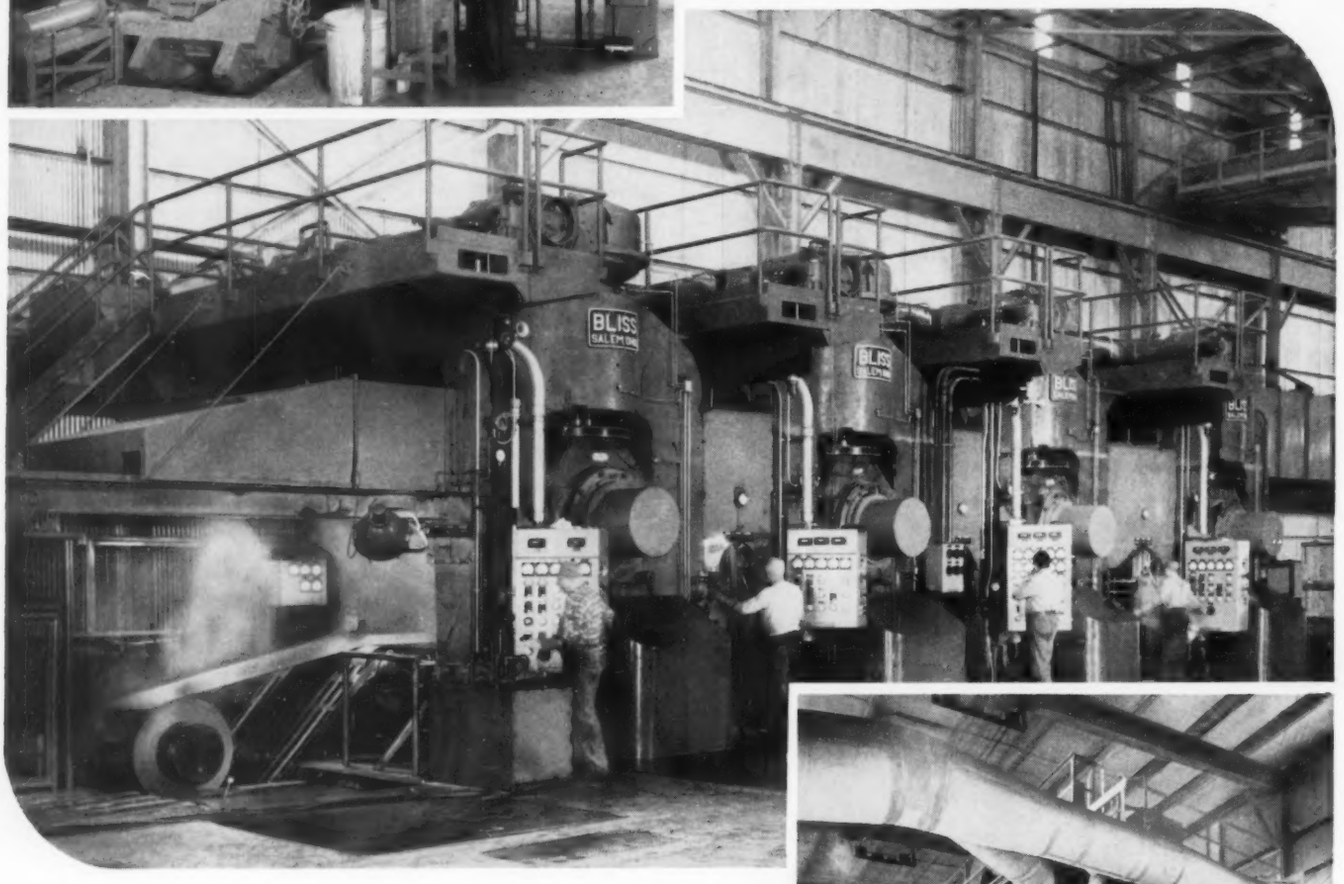
△ For a heavily industrialized country which boasts about its free enterprise system, the United States is woefully backward in its depreciation policy. Instead of standing pat on a policy of long depreciation write-offs, which inflation and technology have rendered ridiculous, it's high time the Treasury Department adopts a realistic policy—a policy more in keeping with that of other countries. Canada, Sweden, Switzerland, Great Britain, West Germany, Argentina, India, to name a few, have write-offs ranging five to ten years, with as much as 50 per cent the first year.

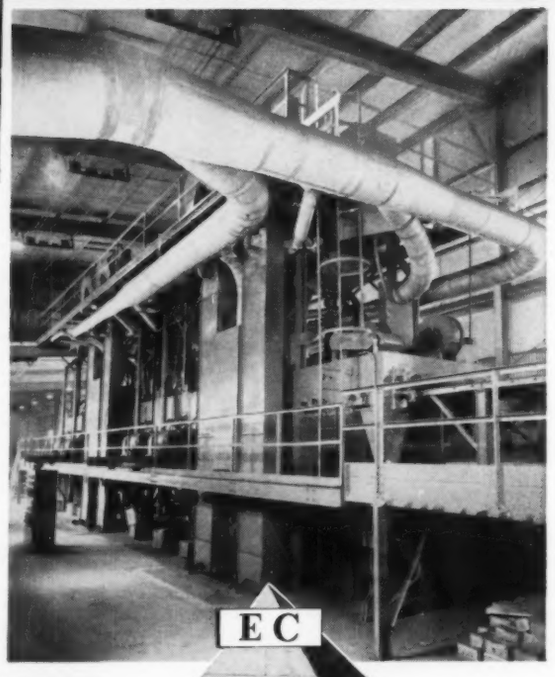
Details of the Canadian policy and its results are discussed by D. S. Holbrook, president of Algoma Steel Corporation, on page 133 of this issue.

56-Inch Four-Stand Cold Mill installed at

EMPIRE STEEL

CORPORATION





THE Eichleay Corporation installed the mechanical equipment, overhead cranes, piping systems, electrical rotating equipment and heavy switch gear units at the Mansfield, Ohio plant of the Empire Steel Corporation. In the performance of this project there was satisfaction in having again participated in the growth and expansion of the steel industry.

As has been the case in all projects of the like Eichleay leaves the Empire Steel plant in the realization that through devotion to good engineering and construction practices the organization's service functions were sustained to the highest degree.

Eichleay services are available to all steel producing companies desirous of having their installation work performed in a competent, economic and workmanlike manner.

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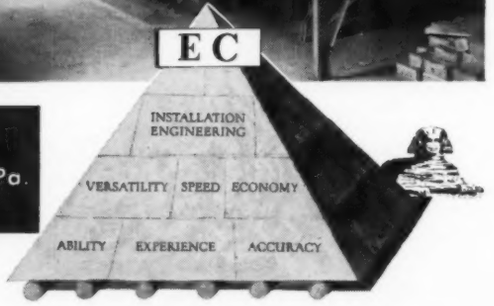
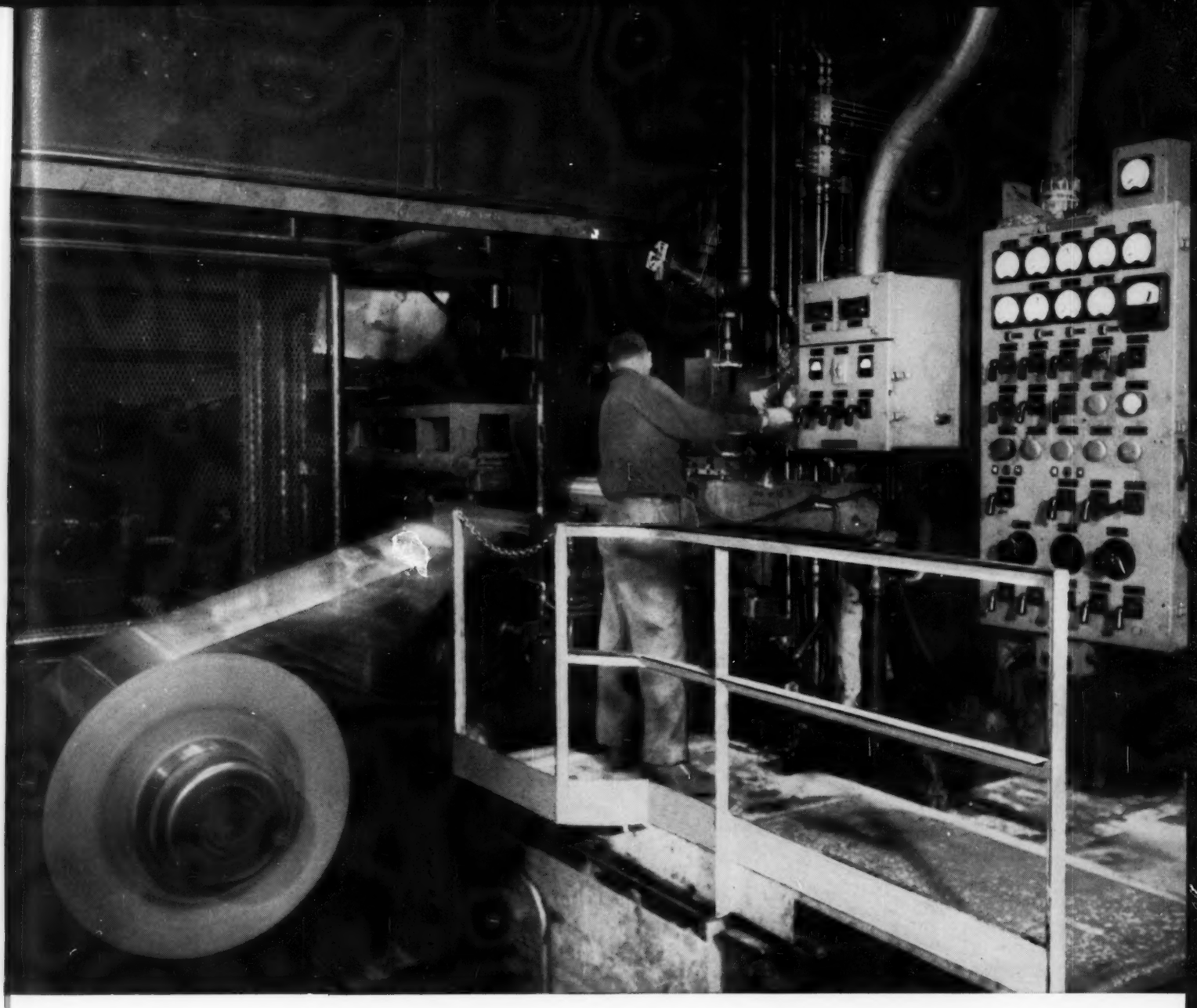




J-96121-1

AT 6000 FEET PER MINUTE...

Westinghouse Automatic Gauge Control on Wheeling Steel's New Tin Plate Mill Assures Plus/Minus .0001 Tolerances

In December, 1957, the new five-stand, 6000-fpm, tandem tin plate mill was officially put in service at Wheeling Steel Corporation's Yorkville, Ohio plant. The new 48″ mill has 22,500-hp total drive capacity to produce tin plate and heavier strip at speeds up to 6000 fpm.

Westinghouse equipment is used, entirely, to Power-Up this modern installation. One of the most outstanding new developments utilized is the Automatic Gauge Control, designed and furnished by Westinghouse—a practical necessity on a high-speed mill of this type.

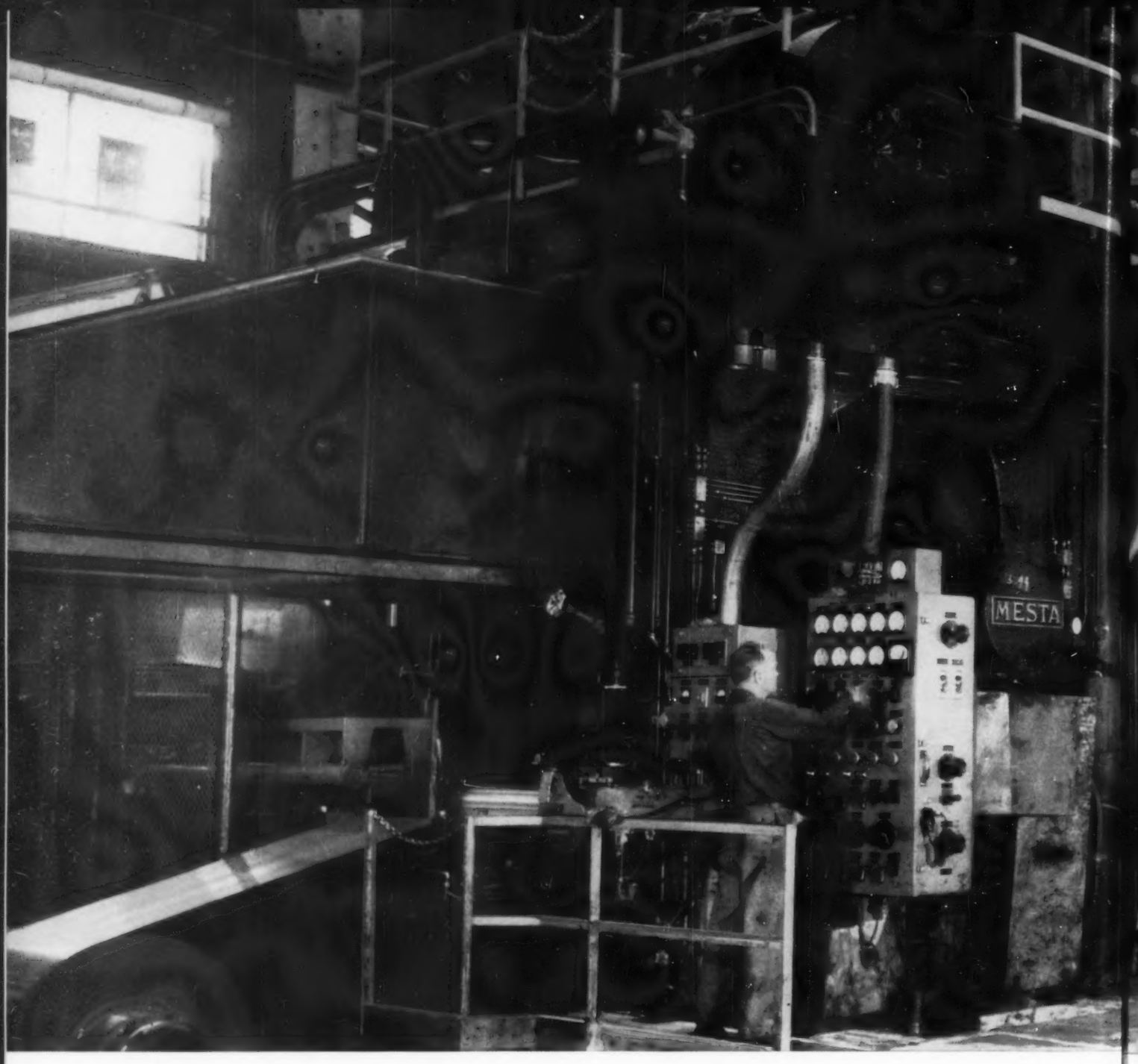
Other Westinghouse equipment furnished for this installation at Wheeling includes: main drive and all auxiliary motors, Magamp* regulators for main drive and variable voltage screwdown controls, M-G sets, brakes, outdoor substations, switchgear, power center, and control centers.

From planning to design, installation and start-up . . . Westinghouse can help you Power-Up. Consult your Westinghouse sales engineer for complete information. Or, write Westinghouse Electric Corporation, 3 Gateway Center, P.O. Box 868, Pittsburgh 30, Pennsylvania.

*Trade-Mark

YOU CAN BE SURE...IF IT'S Westinghouse

Westinghouse Equipment Is Used Throughout the New Five-Stand Tandem Mill at Wheeling Steel Corporation's Yorkville Plant.



New Mill With Automatic Gauge Control Gives More Usable Strip From Every Coil--- Less Production Time Loss

With the automatic gauge control, strip thickness is continually gauged and recorded. Through feedback of signals, the mill automatically adjusts for any variation. Gauge control starts at #1 Stand, controlling the #1 Screwdown to minimize incoming variations. It thereby assures a uniform strip continuously to the mill.

The gauge control at #5 Stand controls the #5 Stand and the reel to adjust the strip tensions and maintain constant gauge of finished strip. The use of this new gauge control assures continuing close tolerance (to within plus/minus .0001) without production slowdown or unnecessary interruption.

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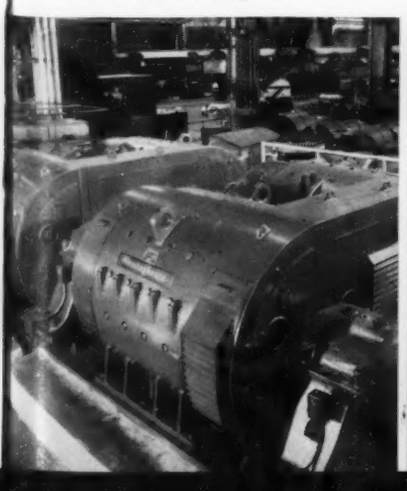
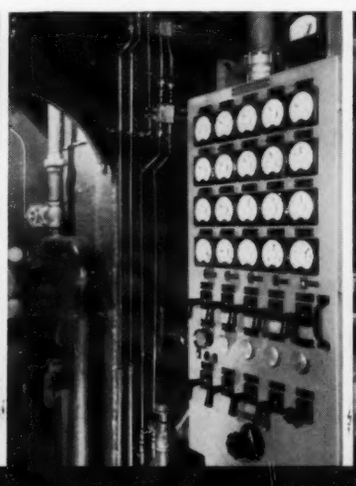
Two 3000-hp double armature motors for #5 Stand twin drive. Side-by-side mounting conserves floor space.

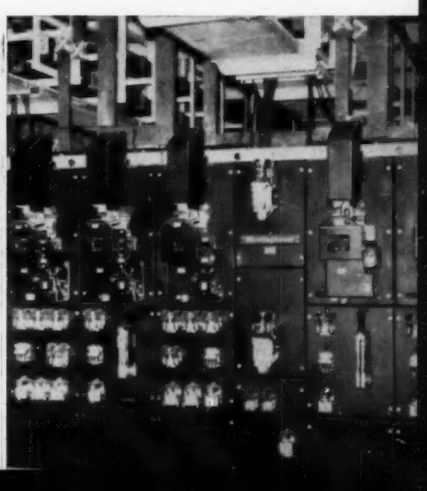


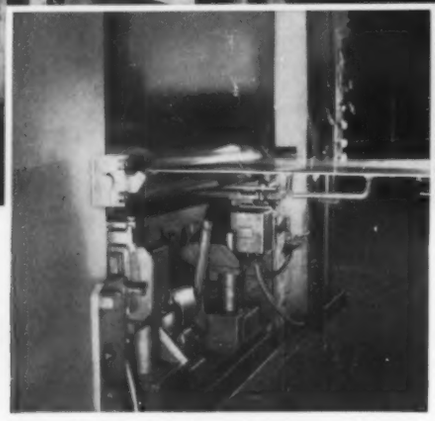
Tensiometer between stands shows strip tensions to guide operators in control of mill, and Westinghouse circular scale meters give maximum readability in minimum panel space.



View of motor room showing main and screwdown M-G sets, switchgear and power center. Controls located on balcony at right.

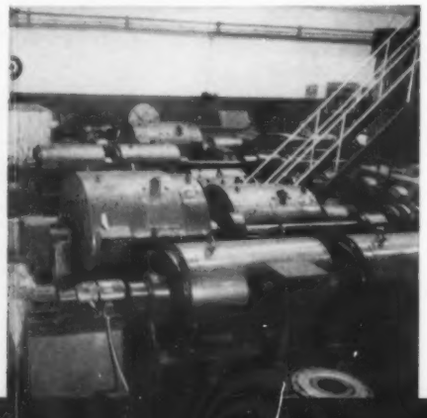
#5 Stand motor and generator line control panels. All circuit breaker and dynamic braking panels are located in basement.





Regulating tensiometer controls #1 Stand to maintain constant tension in strip between stands 1 and 2.

Temper mill main drives. The entry and delivery tension roll twin drives feature special small-diameter machines to enable direct coupling to rolls on 20" vertical centers.



Westinghouse-Powered Temper Mill at Wheeling Gives Higher Tonnage—Less Scrap

As part of their Power-Up program, the Wheeling Steel Corporation recently installed a new 48" two-stand temper-pass mill, rated at 5000 fpm, equipped with 4600 total horsepower.

This Westinghouse equipped mill has increased the amount of strip produced as well as guaranteeing a better product because of the improved control possible.

Westinghouse equipment furnished includes: main drive and auxiliary motors, M-G set, switchgear, control centers and operating controls.

J-96121-4

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UNITED ENGINEERING AND FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at Pittsburgh, Vandergrift, Youngstown, Canton, Wilmington.

SUBSIDIARIES: Adamson United Company, Akron, Ohio
Stedman Foundry and Machine Co., Inc., Aurora, Indiana

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- **Superior finish for coating and die lubrication**
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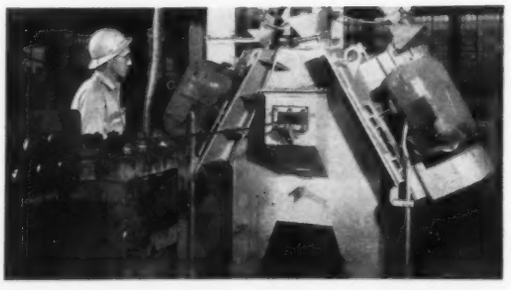
These cost-cutting Wheelabrator advantages are already being obtained by prominent producers of wire products in descaling various size rod at speeds up to 600 f.p.m. New applications in the wire products field are constantly being developed. It will pay you to investigate the Wheelabrator for your cleaning problems. Write today for complete information.



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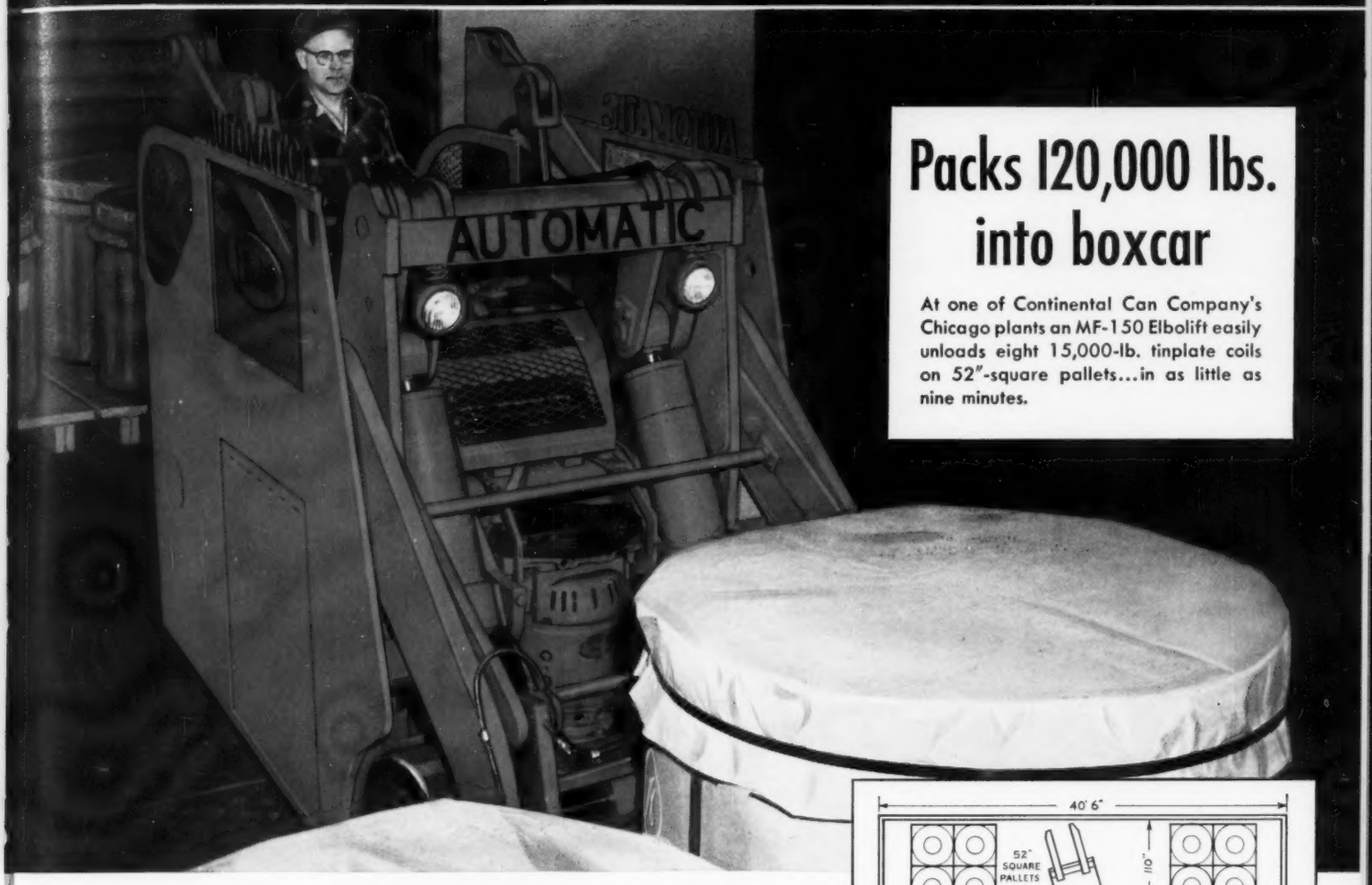
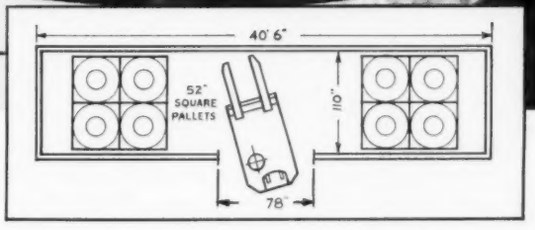
NEW HEAVY-DUTY CARLOADING SENSATION



Packs 120,000 lbs. into boxcar

At one of Continental Can Company's Chicago plants an MF-150 Elbolift easily unloads eight 15,000-lb. tinplate coils on 52"-square pallets...in as little as nine minutes.



Automatic Elbolift does more work... handles heavier loads in less space.

High Stacking In Tight Quarters—Note operator's wide field of vision for stacking while maneuvering in a 53"-wide aisle. End gate optional equipment.

Automatic Elbolift's radical departure in design from the conventional mast-type truck has achieved these superior qualities for working in confined areas:

Compact Design....Elbolift with its stand-up end control design can operate easily through a 78" boxcar door with a 52"-square load.

Increased Visibility....Makes maneuvering in tight areas a snap.

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New Inching Control....4 speeds forward and reverse with foot inching to any speed pre-set or selected by control handle.

Improved Load Distribution....Since tires take up ⅔ of Elbolift's 48" overall width... 32 lineal inches of tire contact with floor provides better distribution of load.

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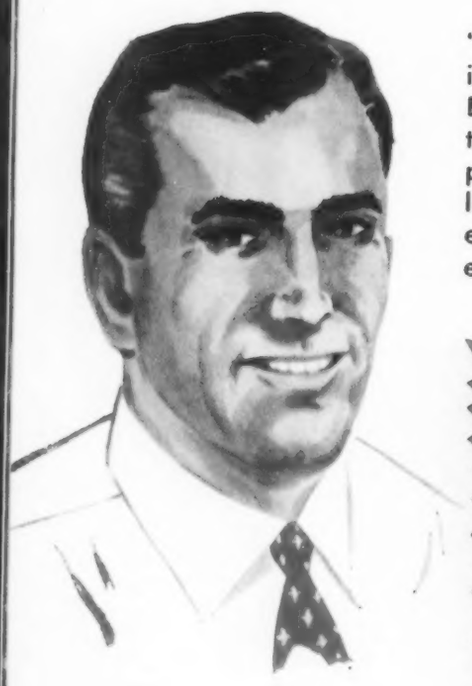
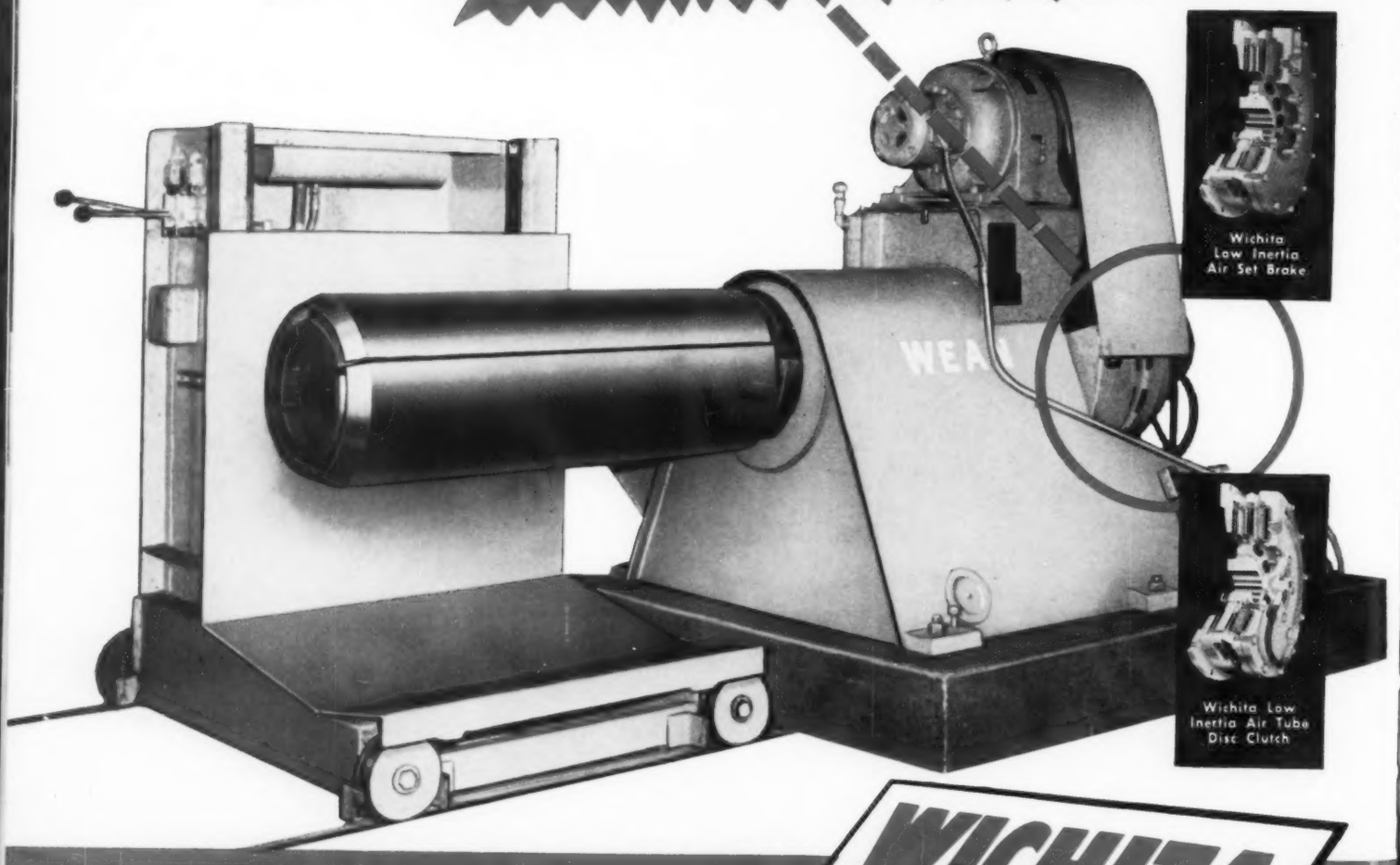


"The illustration shows one of our 52" overhung mandrel uncoilers which is equipped with a Wichita Air Brake," says engineer Krepp of the Wean Equipment Corporation. "We have standardized on Wichita Brakes for this class of uncoiler because of better design, trouble-free operation and performance. We have found that Wichita Brakes give us considerable leeway on size." For peak performance in clutches and brakes on any equipment it will pay you to standardize on Wichita . . . contact your nearest Wichita engineer today!

"Better Design... Trouble-Free Operation... and Performance,"

says J. D. Krepp, Wean Senior Staff Engineer



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WICHITA Clutch COMPANY, INC.
WICHITA FALLS, TEXAS, U.S.A.

patent reviews

By MELVIN NORD, Patent Attorney, Detroit, Mich.

Copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents . . . . . patents reviewed cover period February 11, 1958 through March 4, 1958

METHOD OF CONTROLLING BLAST FURNACES

▲ U. S. 2,822,257, issued Feb. 4, 1957 to Ralph T. Hanna and Carl G. Hogberg, assigned to United States Steel Corp., provides an improved method for controlling the operation of a blast furnace, which enables the blast volume and temperature to be maintained at higher values closer to the critical without risking hanging.

The invention is based on the discovery that a rapid rate of pressure increase usually foretells furnace conditions which cause hanging, irrespective of the absolute pressure. Considerably higher absolute pressure can be tolerated than previously has been considered possible, provided this high pressure is not preceded by an unduly rapid rate of pressure increase. Of course absolute pressures are not neglected altogether, but the absolute pressure at which the control means cuts back the volume or temperature can be considerably higher than that used previously.

Figure 1 shows a typical blast furnace installation which includes a furnace 10, stoves 12, a blower 13, and cold and hot blast lines 14 and 15. The furnace has the usual bustle pipe 16 and tuyeres 17. In accordance with usual practice, the blower 13 directs cold air through the cold blast line, into the stoves, and then through the hot blast line, bustle pipe and tuyeres and into the lower portion of the furnace. The temperature of the blast entering the furnace is commonly about 1000 to 1200 F. The stoves are capable of heating the blast considerably higher than the maximum temperature at which the furnace operates smoothly. Therefore, a portion of the blast goes directly from the cold blast line 14 to the hot blast line 15 via a by-pass 18. An adjustable mixer valve 19 is mounted in this by-pass to control the portion of the blast which takes this route and thus controls the temperature of the blast reaching the furnace. The mixing valve has a mechanical control 20 for varying its opening. The blower 13 has a throttle control 21 for varying the blast volume, which commonly is about 145 cfm per sq ft of hearth area.

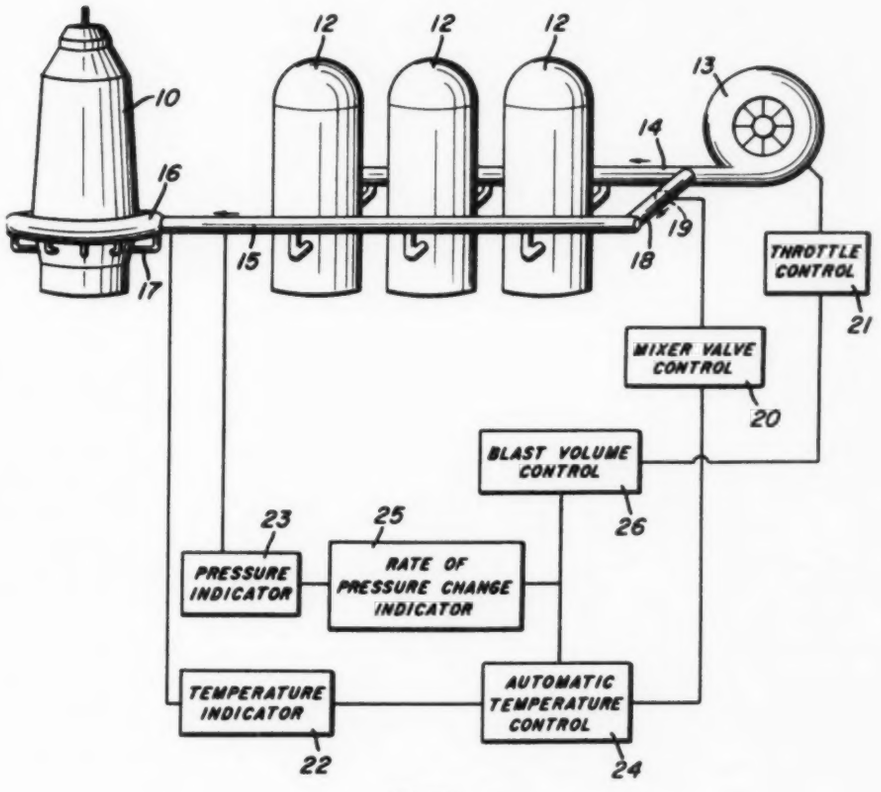


Figure 1

Also in accordance with usual practice, temperature and pressure indicators 22 and 23 are connected into the hot blast line 15 to show the temperature and absolute pressure of the blast entering the furnace. The temperature indicator 22 operates an automatic temperature control 24, which in turn operates the mixing valve control 20 to maintain the temperature at any desired value. In a typical blast furnace having a hearth diameter of 28 ft, the normal operating conditions may be:

Blast volume, cfm 90,000

Blast temperature, F.....1,400
Blast pressure, psig.....20

The critical pressure which causes hanging may be 24 psig. To insure against hanging it is necessary to commence cutting back the temperature or volume whenever the pressure commences to exceed the normal value of 20 psig. The four pound margin is needed as a safety factor, but of course represents an efficiency loss.

In accordance with the present invention, an indicator 25 which shows the rate of pressure change in the hot blast line is connected with the pressure indicator 23. This is preferably an automatic control device, which cuts back the temperature or volume in response to excessive rates of pressure increase.

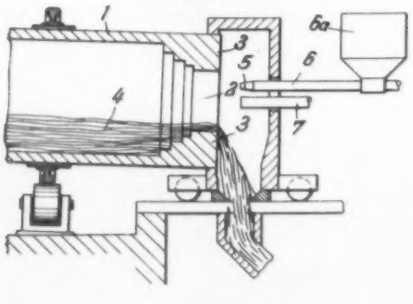
METHOD FOR CHARGING A BLAST FURNACE

▲ U. S. 2,822,936, issued Feb. 11, 1958 to John B. Hazle, assigned to Interlake Iron Corp., describes an improved method and apparatus for charging a blast furnace.

It has been found that where two skip cars are provided, one of which deposits its load on one side of the hopper, and the other of which deposits its load on the other side of the hopper, there is an advantage in imparting a swirl to the material as it enters the bell hopper. This can be accomplished in a satisfactory manner by utilizing a conical receiving hopper, but it has been found that when the material enters the bell hopper in a direction generally opposed to that of rotation, the combined action of the swirling motion imparted to the material by the receiving hopper and the rotating motion of the bell hopper is such that more uniform distribution is provided when the material enters the bell hopper in a direction which is generally opposed to that of rotation of the bell hopper.

The preferred manner of operation is to reverse the direction of rotation during successive dumpings of the skip cars so that the material flowing from each car enters the hopper with a swirling motion in a direction which is generally opposed to the direction of rotation of the hopper. Thus for every dumping operation of skip car No. 1, the hopper would be rotated for example in a clockwise direction, and every dumping operation of skip car No. 2, the hopper would be rotated in a counter-clockwise direction.

Figure 2



REDUCING IRON ORES IN A ROTARY KILN

▲ U. S. 2,823,108, issued Feb. 11, 1958 to Rudolph H. Gerlach, and assigned to Aktiengesellschaft fur Unternehmungen der Eisen-und Stahlindustrie, describes improvements in the Krupp direct process of making iron from iron ores in rotary kilns.

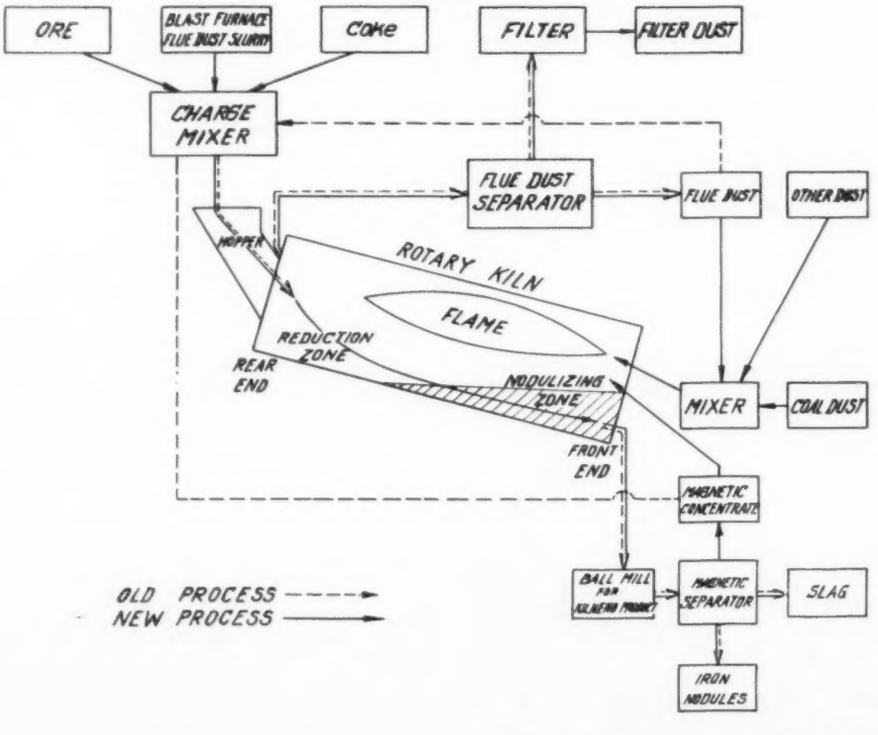
The process is shown in Figures 2 and 3. The rotary kiln 1 is provided with a central discharge opening 2 in its front end wall 3. The kiln contains the charge 4 which is introduced at the mouth of the kiln. The charge 4 is heated by burners 5 by means of a carbonaceous fuel blown into the kiln through pipes 6. Flue dust, mixed in hopper 6a with coke dust, is also blown into the kiln through burners 5, by compressed air. Magnetic concentrate (obtained when the comminuted slag is subjected to magnetic separation) is introduced into the kiln by way of pressure line 7.

The flowsheet (Figure 3) illustrates the work cycle of a rotary kiln, beginning with the charging of the kiln, the passage of material through the latter, the separation of slag, nodules and magnetic concentrate, and the separation of the flue dust from the waste gases. According to the usual processes, the cycle is completed as illustrated by dashed lines, by returning the magnetic concentrate and flue dust to the rear end of the kiln and adding it to a next following charge.

According to the work cycle in the present process, illustrated in full lines in the flow sheet, the flue dust alone or in mixture with dust from other waste gases—for instance, from the flue gases of blast furnaces—is mixed with the carbonaceous fuel and introduced into the kiln as described, while the magnetic concentrate is introduced separately into the nodulizing zone of the kiln through the front (or discharge) end of the latter.

The flue dust from rotary kiln processes may contain approximately 6 to 10 per cent of iron, 15 to 25 per cent of zinc and/or other volatilizable metals, and about 25 to 30 per cent of carbon particles.

Figure 3



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(Top photo) In the refining area **Square D Control Centers** provide a portion of the centralized control of pumps and compressors. In the maintenance shop they control power, heating, ventilating and lighting.

(Lower photo) Another Square D Control Center, located in the Employe Relations Building, provides pushbutton control of air-conditioning units and compressors. Infirmary X-Ray equipment and parking lot lighting also are remotely controlled from this Center.

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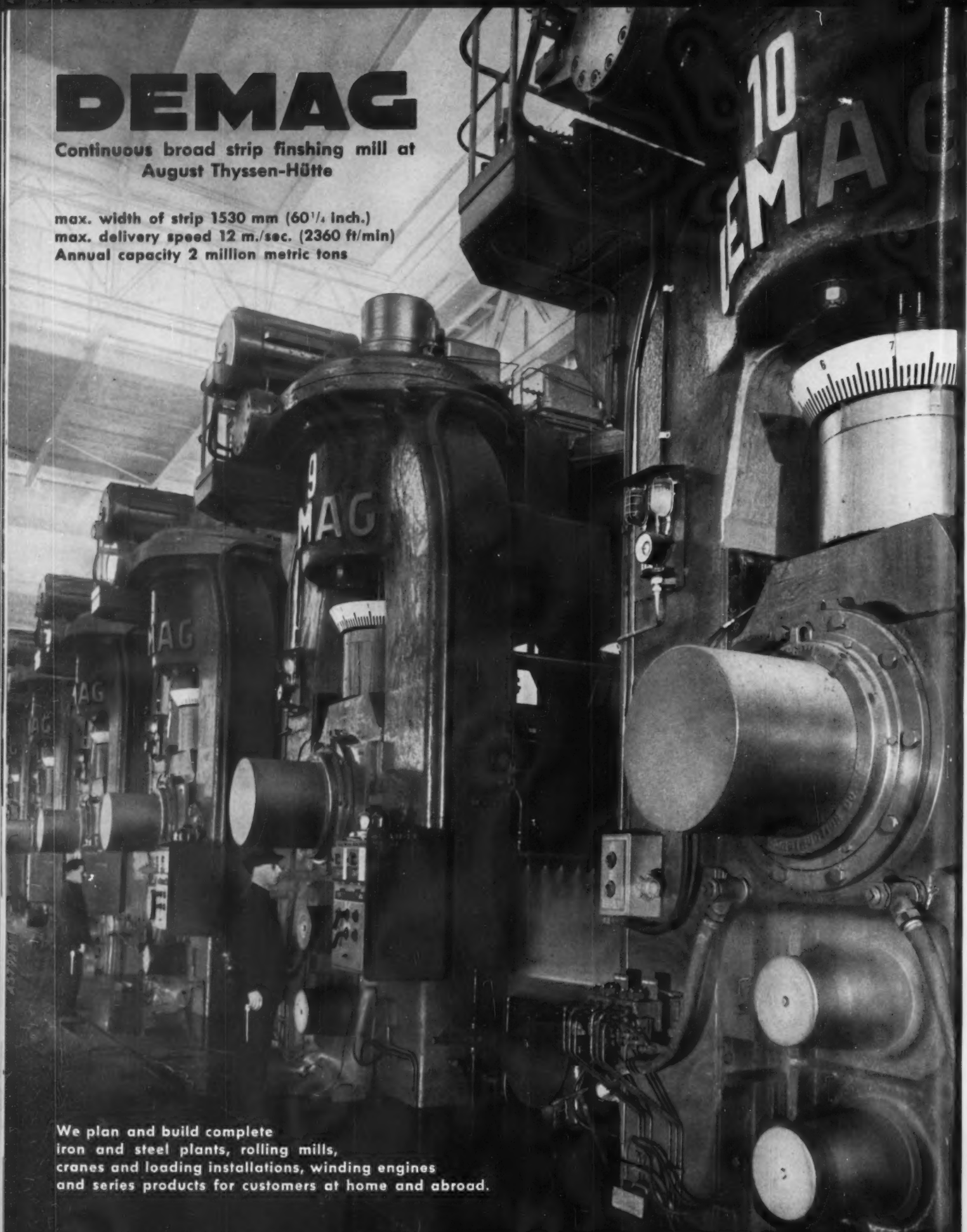
max. delivery speed 12 m./sec. (2360 ft/min)
Annual capacity 2 million metric tons



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It is preferred to introduce the flue dust from the next preceding work cycle of the kiln, alone or in mixture with suitable dusts from the waste gases of other metallurgical processes, such as flue dust from blast furnaces waste gases, and in particular flue dust containing zinc oxide, lead oxide, and/or oxides of other volatilizable metals into the kiln in such a manner that it is discharged into the heating flame burning in the kiln interior.

When proceeding in this manner, the carbonaceous portion of the flue dust is burnt, the heat recovered therefrom permitting a reduction in the amount of new carbonaceous fuel required to heat the kiln. The iron oxide particles of the flue dust are united with the charge of the kiln, and the other metal oxides are rapidly volatilized, due to the presence in the dust in the form of fine particles.

Thus, the amount of flue dust which must be reintroduced into the kiln is greatly reduced.

Due to the reduction of the total amount of flue dust obtained from each cycle, and of the fact that the amount of oxides of volatilizable materials leaving the kiln remains substantially the same, the percentage of oxides of volatilizable materials leaving the kiln remains substantially the same, the percentage of oxides of volatilizable metals in the flue dust resulting in the present process is considerably higher. Furthermore, owing to the greater rate of throughput through the kiln it is possible to obtain a desired percentage of volatilizable metal oxides in the flue dust more rapidly than by known processes.

MANUFACTURE OF HIGH GRADE PIG IRON

▲ U. S. 2,823,109, issued Feb. 11, 1958 to Koji Sudo, describes a process for producing a high grade pig iron comparable to charcoal iron, by using powdered coke or powdered coal.

In the comparison of coke iron with charcoal pig iron in their content of ferrous oxide, even when both types of iron have similar chemical compositions as determined in the ordinary analysis, the FeO content of the latter iron always ranges from one-tenth to several tenths that of the former. Such an extremely low content of ferrous oxide is one of the important factors for the excellent inherent properties of charcoal pig iron. This fact is considered to be ascribed to the difference between the chemical reaction in charcoal furnaces and that in the coke furnace.

In the present invention, briquettes are formed from finely-divided ore and pulverized carbonaceous materials such as coke and coal, by using quick lime as a binding agent. These briquettes are dried and hardened, after which they are sintered. Subsequently, powdered iron ore is directly reduced by the solid carbonaceous material in the briquettes. The pig iron is melted, while the acidity of the slag in the furnace is kept at a certain degree. By further reaction with said slag, a slight amount of FeO solidly dissolved in molten pig iron is converted into ferrous oxide silicate, which is then reduced by the surrounding carbonaceous material to pure iron. The iron thus obtained is transferred into the molten iron. Thus a high grade pig iron can be obtained containing an extremely slight amount of FeO, as in the case of charcoal iron, by using powdered coke or pulverized coal.

APPARATUS FOR HOT DIP GALVANIZING

▲ U. S. 2,823,641, issued Feb. 18, 1958 to Nelson E. Cook and Samuel L. Norteman, assigned to Wheeling Steel Corp., describes apparatus for applying, to metal strip to be coated, a flux which reacts with the molten coating metal at the temperature of the molten coating metal so that the flux cannot be floated upon the molten coating metal.

In Figure 4, steel strip to be galvanized is shown passing about guide rolls 2, 4, 10 and 13.

The guide rolls 4 are mounted with their lower portions immersed in a bath of flux in water solution in a receptacle 3. The guide rolls 4 are shown as having their axes slightly above the surface of the flux solution. The flux solution will for purposes of example be deemed to be a water solution of 45 per cent ammonium chloride

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,822,591	2/11/58	Hot top casing	Oswald Refractories Co.
2,822,768	2/11/58	Metallic skewbacks for furnace roofs	United States Steel Corp.
2,822,930	2/11/58	Apparatus for handling billets	York Engineering & Construction Co.
2,823,027	2/11/58	Ceramic checker mass	Wulff Process Co.
2,823,028	2/11/58	Ladle and trunnion ring	York Engineering & Construction Co.
2,823,061	2/11/58	Self-dumping bucket	United States Steel Corp.
2,823,114	2/11/58	Forgeable high strength austenitic alloy with columbium-tantalum addition	The Babcock & Wilcox Co.
2,823,812	2/18/58	Shock absorbers for billets	Western Electric Co., Inc.
2,823,912-3	2/18/58	Sinter cooler	Koppers Co., Inc.
2,823,939	2/18/58	Apparatus for releasing coke oven doors	Koppers Co., Inc.
2,823,992	2/18/58	Alloy steels	American Metallurgical Products Co.
2,823,993	2/18/58	Steel alloy for use in valve seats	Maschinen-und Armaturenfabrik K.G.
2,824,321	2/25/58	Strip cleaning and processing machine	The McKay Machine Co.
2,824,529	2/25/58	Metallurgical furnace roof	Lewis B. Ries
2,824,731	2/25/58	Cupolas having thin wall portions	Modern Equipment Co.
2,824,762	2/25/58	Cupola charging buckets	Modern Equipment Co.
2,824,792	2/25/58	Reductior. of metal oxides	Texaco Development Corp.
2,824,795-7	2/25/58	Forgeable high-strength austenitic alloys	The Babcock & Wilcox Co.
2,824,798	2/25/58	Austenitic alloys	Allegheny Ludlum Steel Corp.
2,824,820	2/25/58	Method of spheroidizing hypereutectoid steels	Allegheny Ludlum Steel Corp.
2,825,402	3/4/58	Flying shears	Theodor Wuppermann G. m.b.H.
2,825,405	3/4/58	Hydraulically operated ingot-shearing machines	Schloemann Aktiengesellschaft
2,825,546	3/4/58	Controlling mechanism for furnace firing equipment	Alfred F. Seibel
2,825,550	3/4/58	Wind box sealing construction for sintering machines	McDowell Co., Inc.
2,825,669	3/4/58	Low alloy steel for oil well tubing	Societe des Acieries de Pompey
2,825,679	3/4/58	Briquetting of coke by direct heating	Kurt Baum

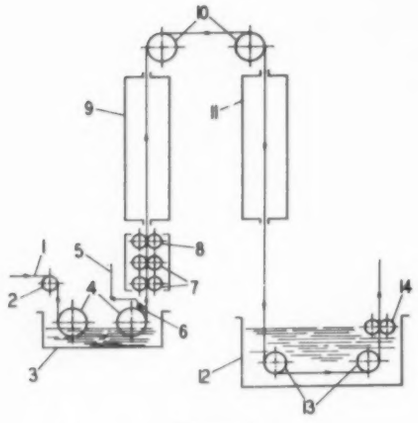


Figure 4

and 55 per cent zinc chloride. The strip 1 moves vertically upwardly from the flux bath as shown. There is a tendency in the flux bath for more flux to adhere to the surface of the strip disposed away from the guide rolls 4 than to the surface of the strip disposed against the guide rolls, and to compensate for that tendency flux solution is introduced through a pipe 5 and flowed into the crotch 6 between the right-hand guide roll 4 and the strip as shown in the drawing. This insures the application of a relatively uniform coating of flux to the respective faces of the strip. The bath of flux is replenished to compensate for the flux removed on the strip. The flux solution may have a specific gravity of 10-20° Baumé and a temperature of 150-200 F. The flux solution may, if desired, be continuously recirculated and filtered.

As the strip moves upwardly from the crotch 6 it carries on both faces a relatively heavy layer of flux solution. The strip passes between rubber surfaced metering rolls 7 and levelling brushes 8 which may, for example, be nylon bristle brushes. The rolls and brushes are for the purpose of removing part of the flux solution and insuring that the unremoved flux solution is in a smooth uniform coating on the strip. The metering rolls 7 turn in the direction in which the strip tends by friction to rotate them and at the same surface speed as the strip. They are preferably rotated by frictional engagement with the strip, although they may be independently driven. The metering rolls 7 are grooved. The portions of the metering rolls 7 which engage the strip squeeze off the flux solution which can pass through, later to be smoothed out or levelled by the levelling brushes 8. The levelling brushes 8 may be rotated or not, and if they are rotated they may be rotated in either direction at selected speeds. Normally the levelling brushes 8 will be rotated slowly in the direction opposite the direction in which the strip tends by friction to rotate them.

As the strip carrying a controlled coating of liquid flux solution passes upwardly from the brushes 8, it enters a heating chamber 9 in which the strip is heated to evaporate the water in the flux solution. The strip is free from engagement by any portion of the apparatus after it leaves the brushes 8 until it reaches the left-hand guide roll 10. As a consequence, the flux is dried on the strip uniformly and smoothly.

The strip reaching the left-hand guide roll 10 therefore has on both faces a substantially dry uniform coating of flux at a temperature of the order of 250 F. The strip passes over the guide rolls 10 and then downwardly toward the galvanizing pot 12 which contains molten spelter containing aluminum. In its downward passage, the strip passes through a further heating chamber 11 wherein its temperature is raised to a temperature approaching the maximum temperature of stability of the dry flux coating on the strip. That temperature in the case of flux containing 45 per cent of ammonium chloride and 55 per cent of zinc chloride is 450 to 500 F.

Thus as the strip enters the bath of spelter in the galvanizing pot 12, its temperature relatively closely approaches the temperature of the molten spelter with the result that the dry flux coating on the strip reacts with relatively great rapidity with the spelter. The reaction is so rapid that it is substantially complete by the time the strip reaches the left-hand guide roll 13 in the galvanizing pot. The coated strip emerges from the galvanizing pot 12 between the rolls 14 which may be the conventional exit rolls of the galvanizing rig.

CONVERTER

▲ U. S. 2,825,551, issued March 4, 1958 to Walter L. Kerlie, and assigned to United States Steel Corp., describes a surface blown converter for refining pig iron, in which improved circulation of slag and metal at the surface of the bath are obtained.

As shown in Figures 5 and 6, the converter has a metal shell 2 with a refractory lining 3 and is mounted for rotation with its axis in a horizontal position. Its mounting includes a pair of axially spaced rocker rails or wheels 4 which are secured to the shell 2 concentrically with respect to the axis of the vessel 1 and have rolling engagement on supporting rollers 5. A sprocket or gear drive (not shown) is provided for tilting the vessel 1 to and from its upright blowing position.

The inner end of the vessel 1 is closed by a manhole cover which includes a mounting plate 6 and a preformed and tapered dolomite block 7, which are detachably secured to the shell 2. The provision of a removable manhole in this manner enables replacement of the refractory lining 3 according to the practice used in relining standard basic Bessemer converters.

A wind-box or manifold 10 extends between the rocker wheels 4 and is supplied with oxygen, air or oxygen-enriched air from a coupling 11 which is connected to the manifold 10 by a conduit 12. The coupling 11 is removably secured to the shell 2 about the plate 6 and is connected to an air supply conduit 13 which is rotatably supported in suitable bearings (not shown).

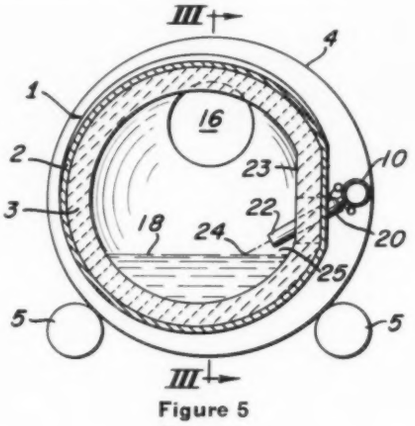
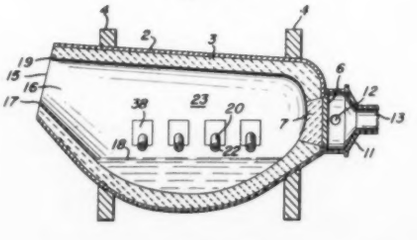
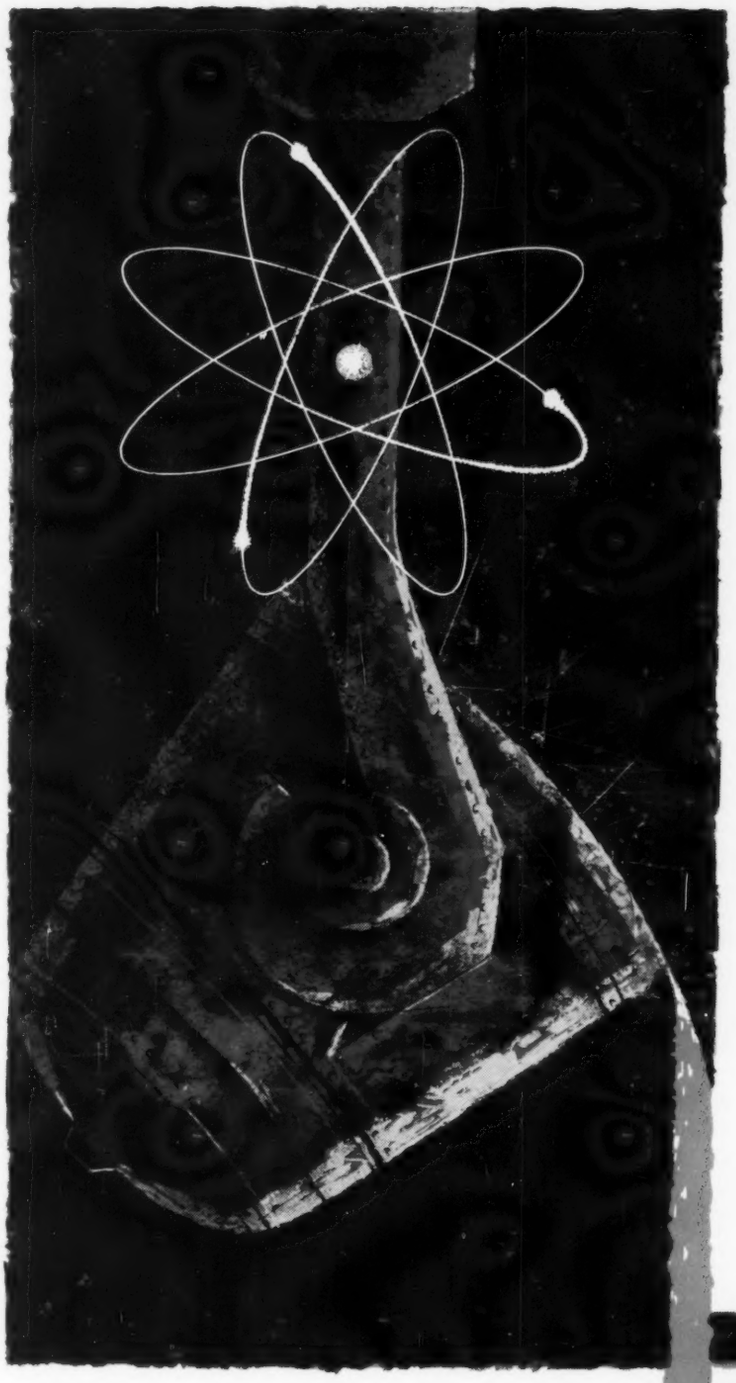


Figure 5

Figure 6





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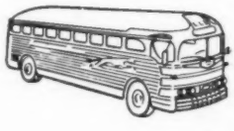

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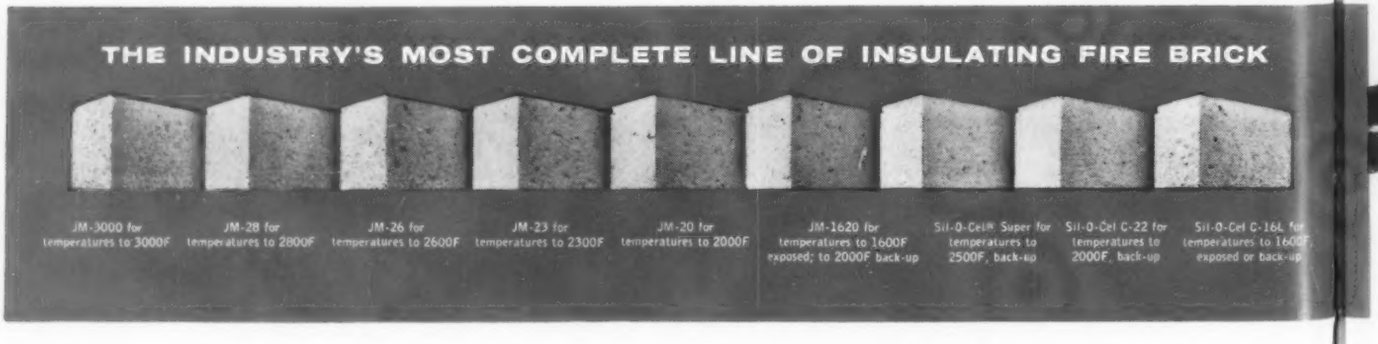
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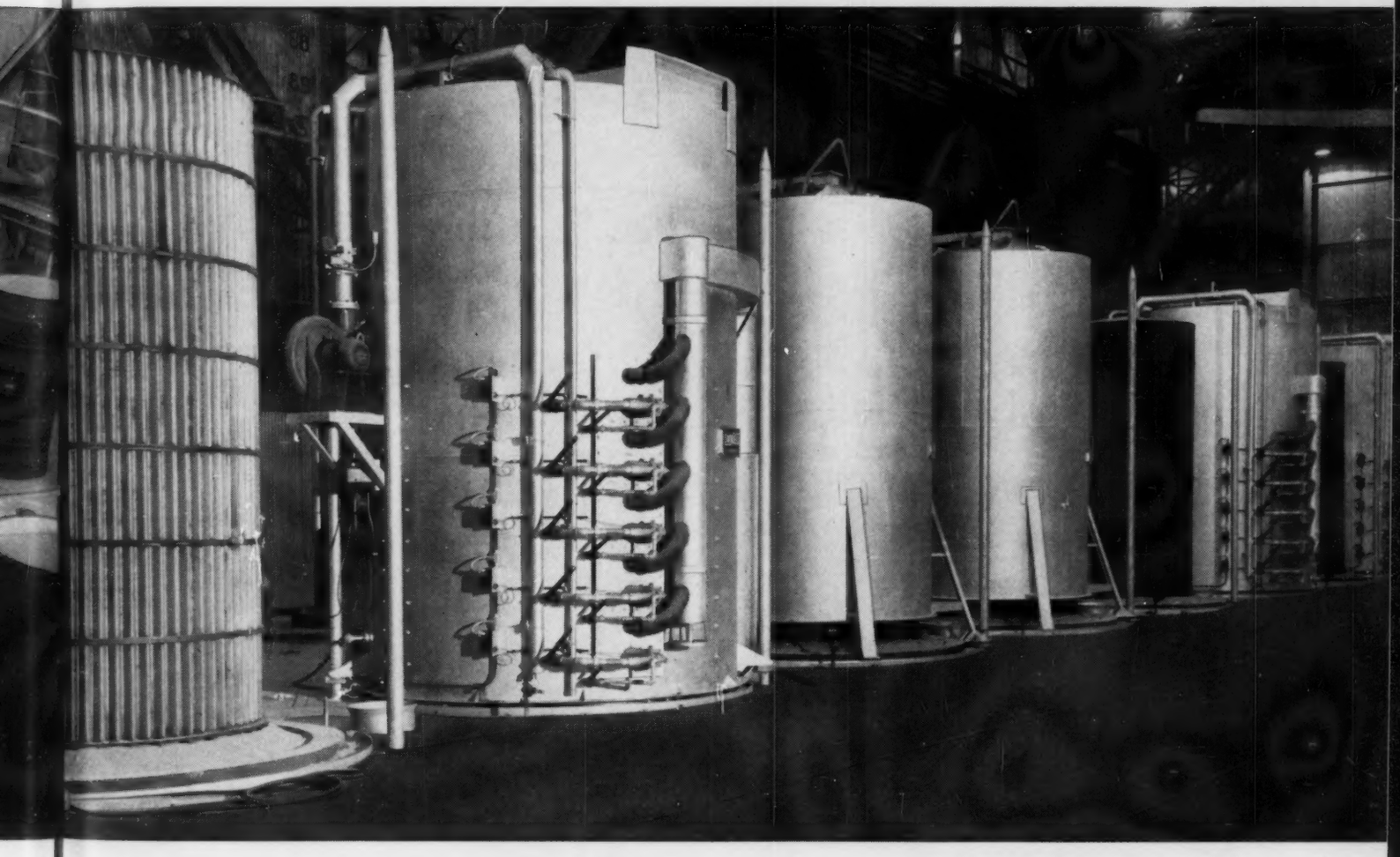

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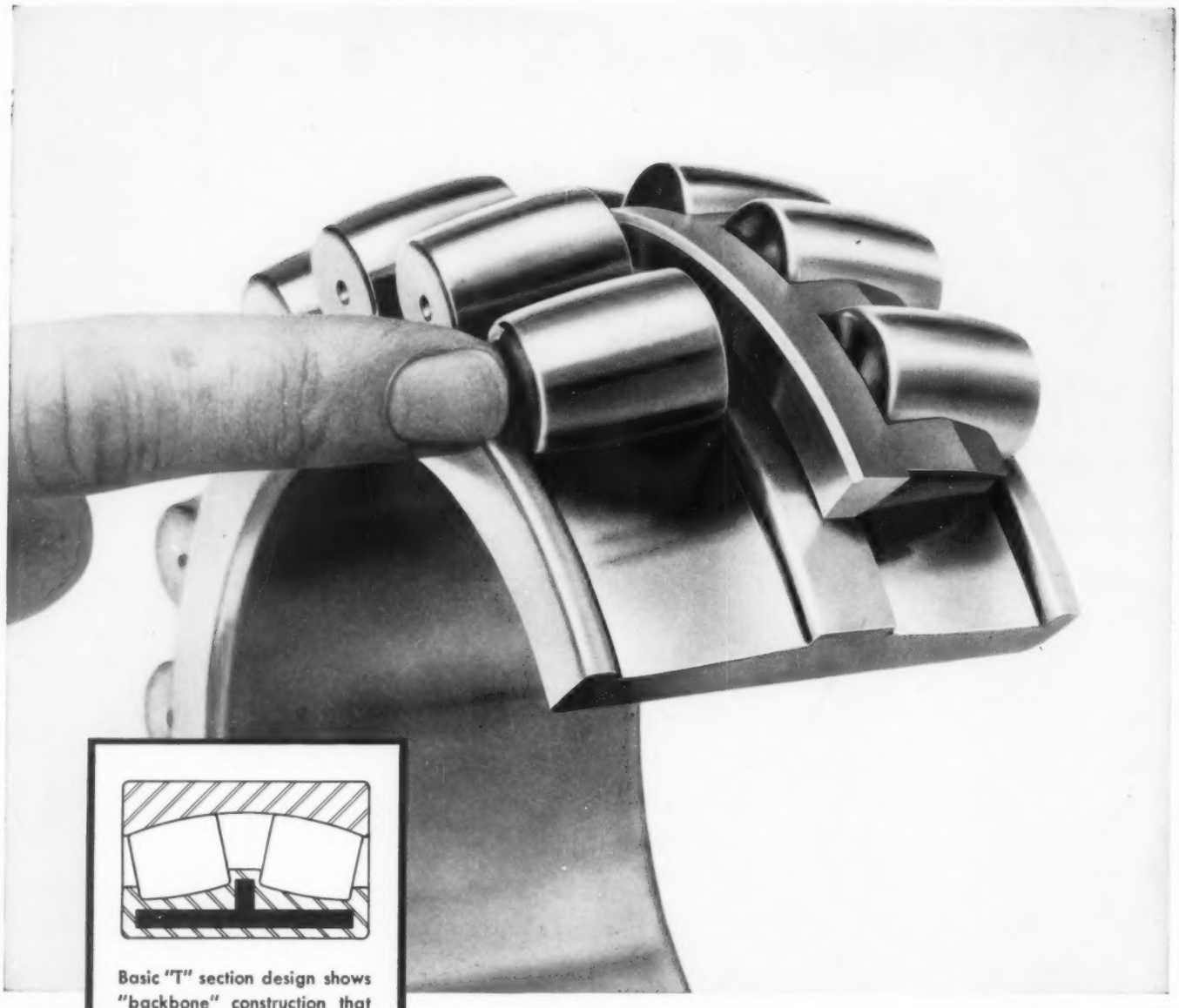
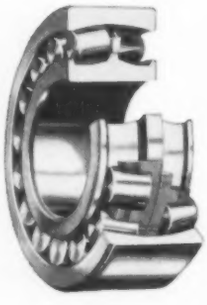


Basic "T" section design shows "backbone" construction that insures positive roller guidance and stability without skewing under all load conditions.



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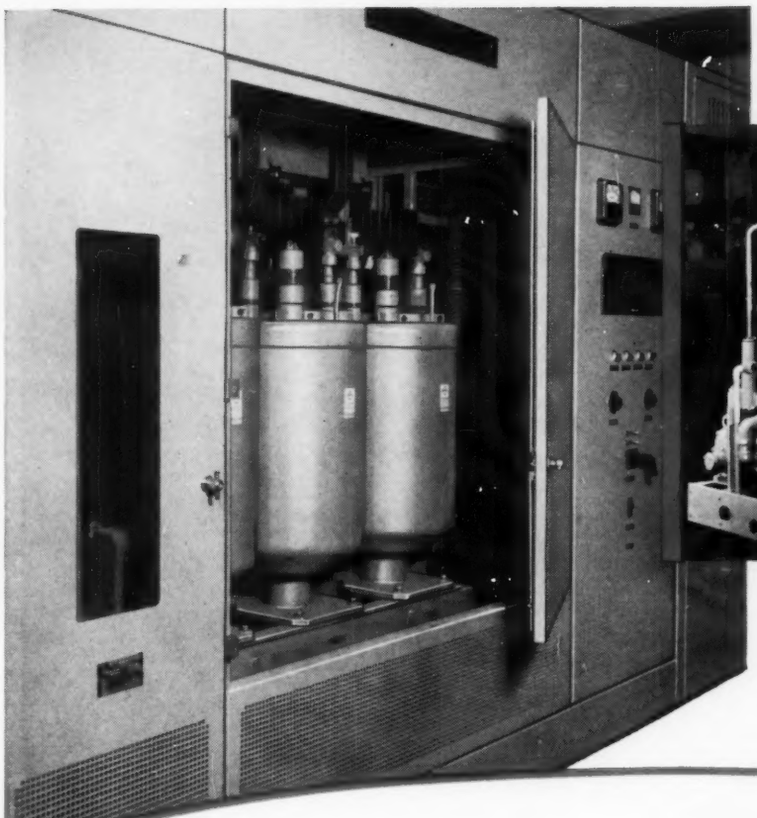
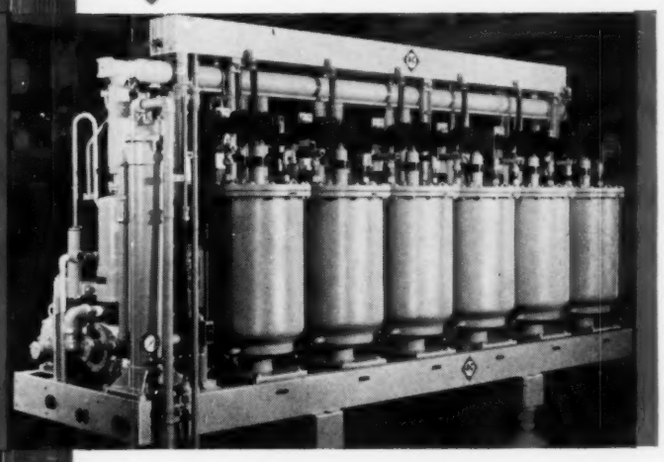


Open pumped tube unit permits easy access for inspection. Easy to recondition in field.



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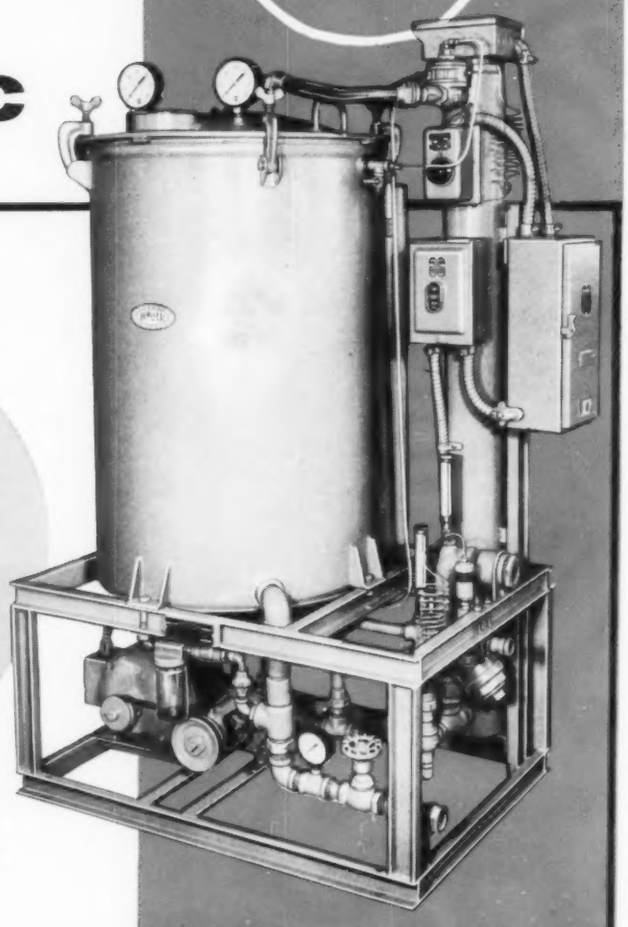

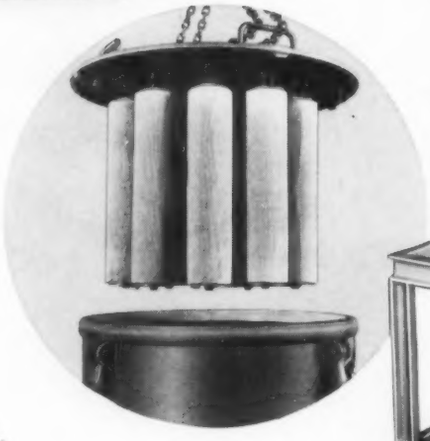

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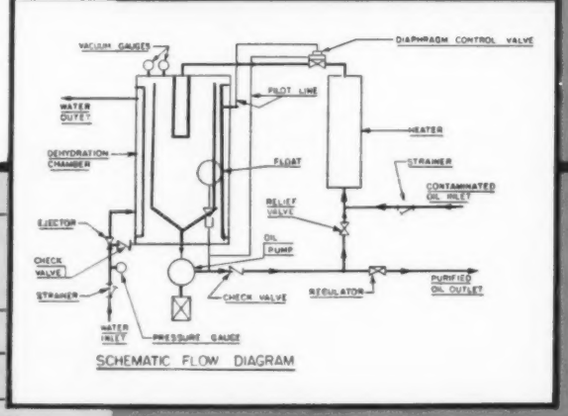

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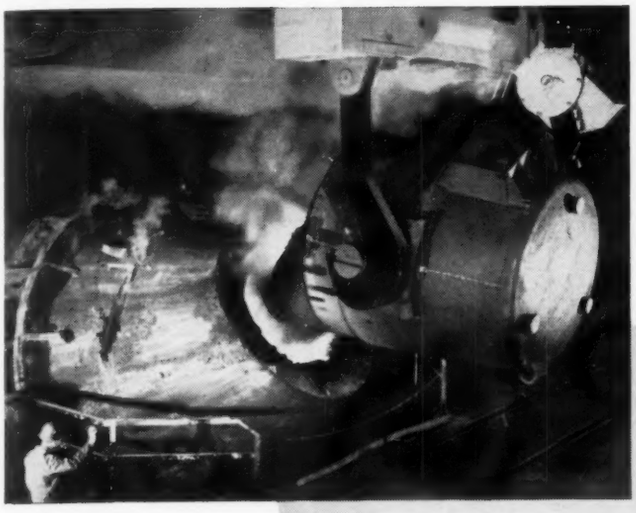

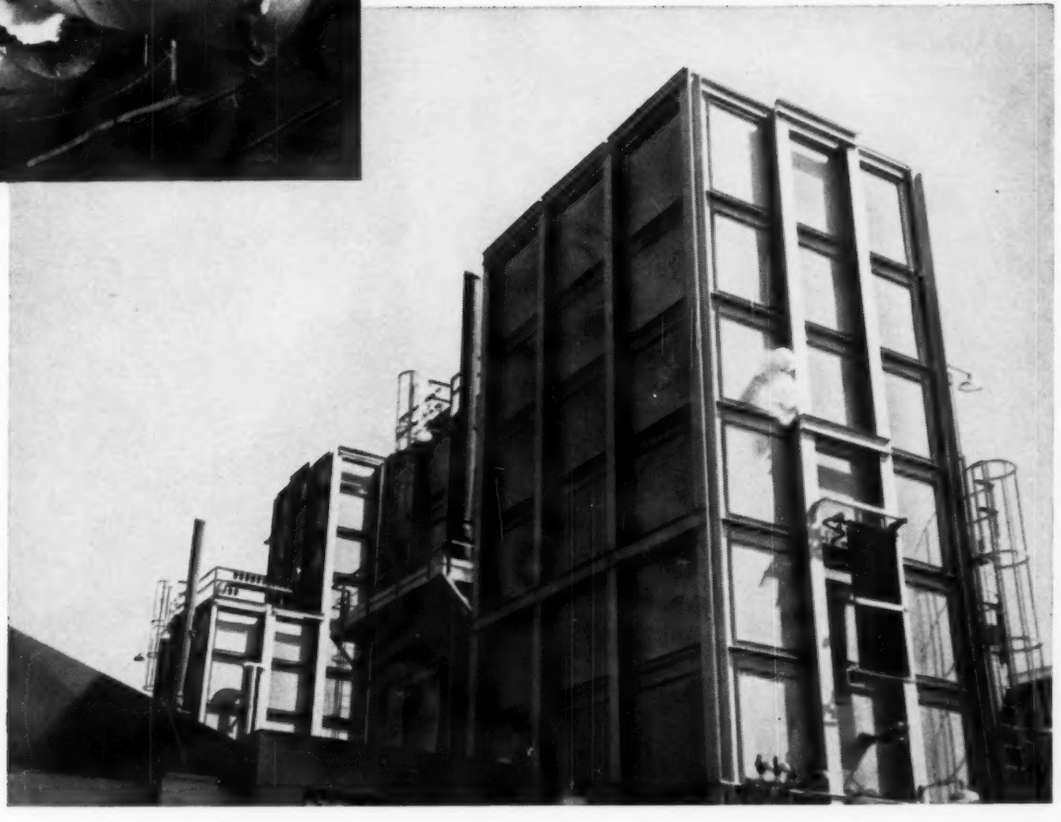

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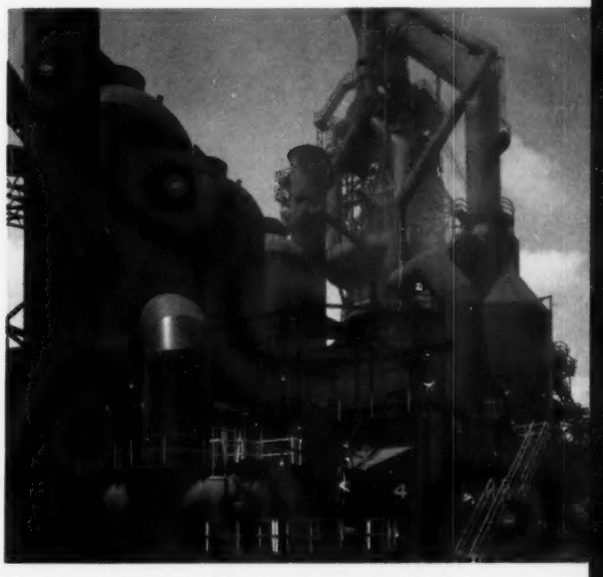

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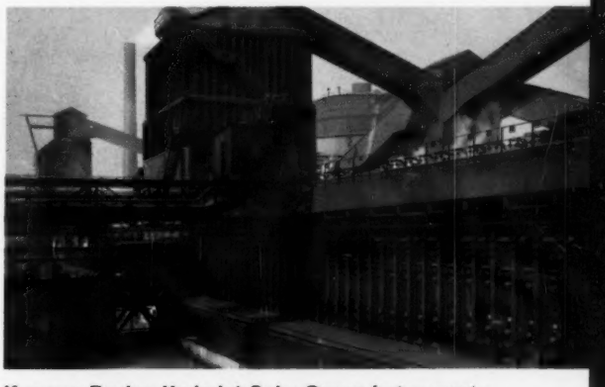

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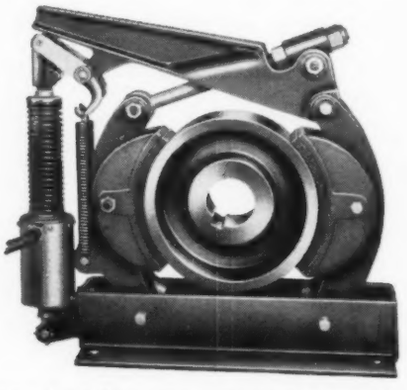

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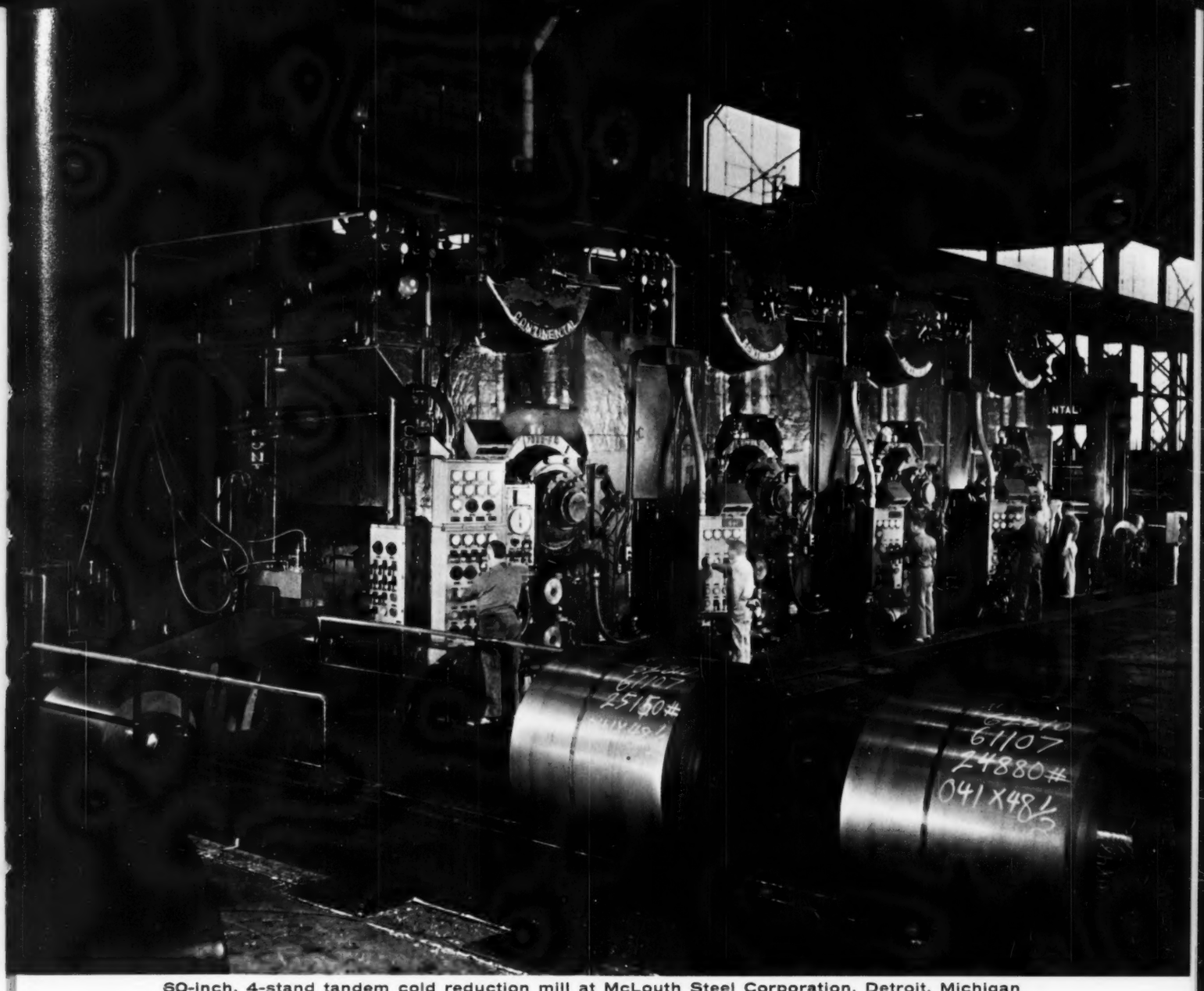


60-inch, 4-stand tandem cold reduction mill at McLouth Steel Corporation, Detroit, Michigan

BLAW-KNOX COLD STRIP MILLS

Blaw-Knox designs and builds all types of cold reduction and temper mills for ferrous and non-ferrous work. Other Blaw-Knox equipment for the metals industry includes complete rolling mill installations including all auxiliary equipment for ferrous and non-ferrous metals, iron, alloy iron and steel rolls, Medart cold finishing equipment, carbon and alloy steel castings, fabricated steel plate or cast-weld design weldments, steel plant equipment, and heat and corrosion resisting alloy castings.

BLAW-KNOX

BLAW-KNOX COMPANY

Foundry and Mill Machinery Division
Blaw-Knox Building • 300 Sixth Avenue
Pittsburgh 22, Pennsylvania

For Dust Collection, here are

3,370 REASONS WHY

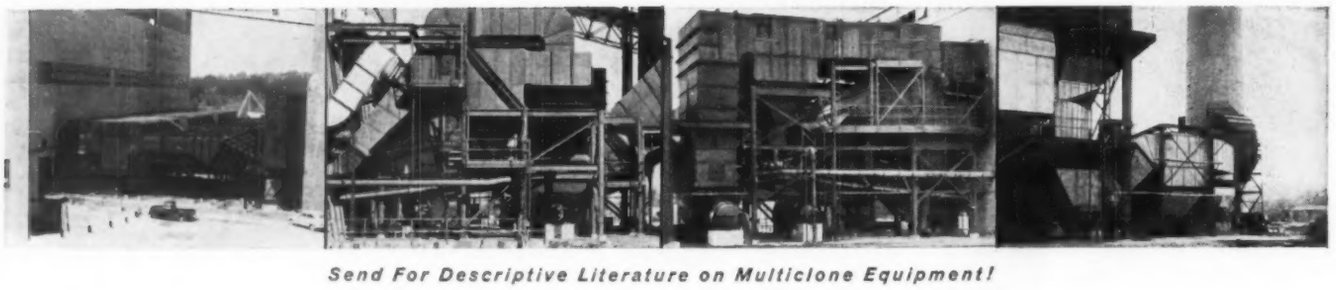
You're Years Ahead with MULTICLONE

The tabulation sheet shown here is over 40 feet long, filled top to bottom with single-spaced typewriter listings as in the enlarged section above...

- Each typewritten line tabulates an installation of Multiclone equipment—an installation of from one to nine separate Multiclone units!
- These installations have been made in all parts of the world and in plants operating under widely-varying conditions.
- They include installations on virtually every type of dust collection problem—cement, non-metallic minerals, ferrous and non-ferrous metals, chemicals and many others.

New Multiclone installations are being made every day, but at the time this tabulation was made there were 3,370 Multiclone units giving superior service to industry throughout the United States, Canada and other countries.

What does this mean to you? Simply this--when you select "Multiclone" you are getting equipment that has over a quarter-century of experience behind it...equipment backed by the industry's greatest fund of "know-how" in modern small tube, high-efficiency cyclonic collection. Although this unequalled experience is a part of every Multiclone installation, you pay nothing extra for this vital advantage!



Send For Descriptive Literature on Multiclone Equipment!

COTTRELL Electrical Precipitators
MULTICLONE Mechanical Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
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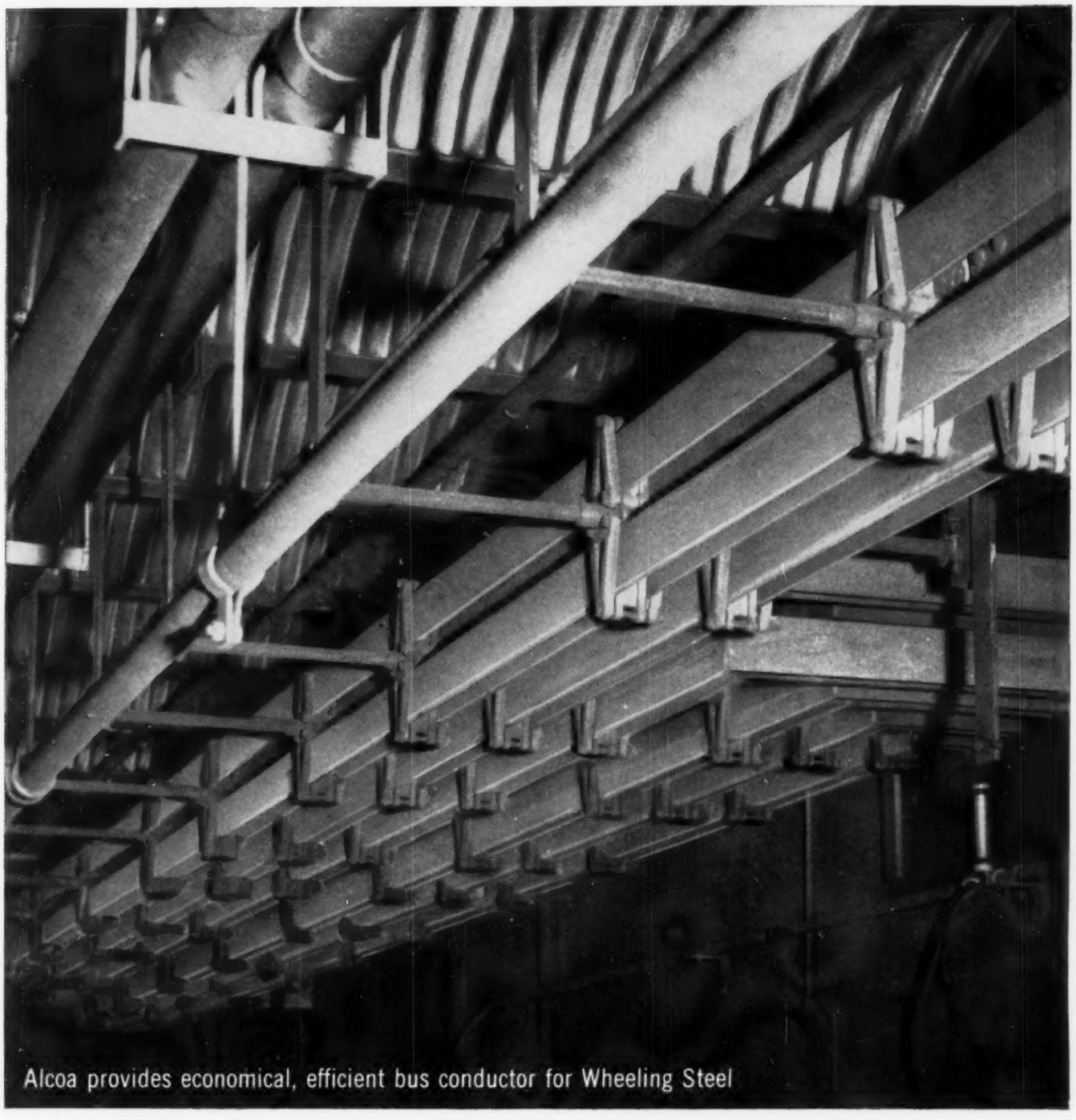

Alcoa provides economical, efficient bus conductor for Wheeling Steel

ECONOMY, PLUS 23 YEARS OF SERVICE, EARNS ALCOA ANOTHER BUS CONDUCTOR JOB AT WHEELING STEEL

In 1934, Wheeling Steel Corporation first installed Alcoa® Aluminum Bus Conductor in its Yorkville, Ohio, mill. This first installation was designed to carry power from a bank of transformers to operate equipment at the washers, picklers, finishing mill and tin house.

In 1957, Alcoa Bus Conductor was again chosen—this time to carry 600-v, 5,000-amp dc to the No. 2 tandem mill. Compared to a copper system, Wheeling Steel got the same conductivity at half the cost. The light weight of the aluminum bus (one-half that of copper) contributed a further significant cost saving.

Why not take advantage of the same savings that helped Wheeling Steel! Call Alcoa or your Alcoa distributor. Aluminum Company of America, 2310-G Alcoa Bldg., Pittsburgh 19, Pa.

DISTRIBUTORS OF ALCOA ALUMINUM BUS

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Your Guide to the Best in Aluminum Value

ALCOA ALUMINUM
ELECTRICAL CONDUCTORS AND ACCESSORIES
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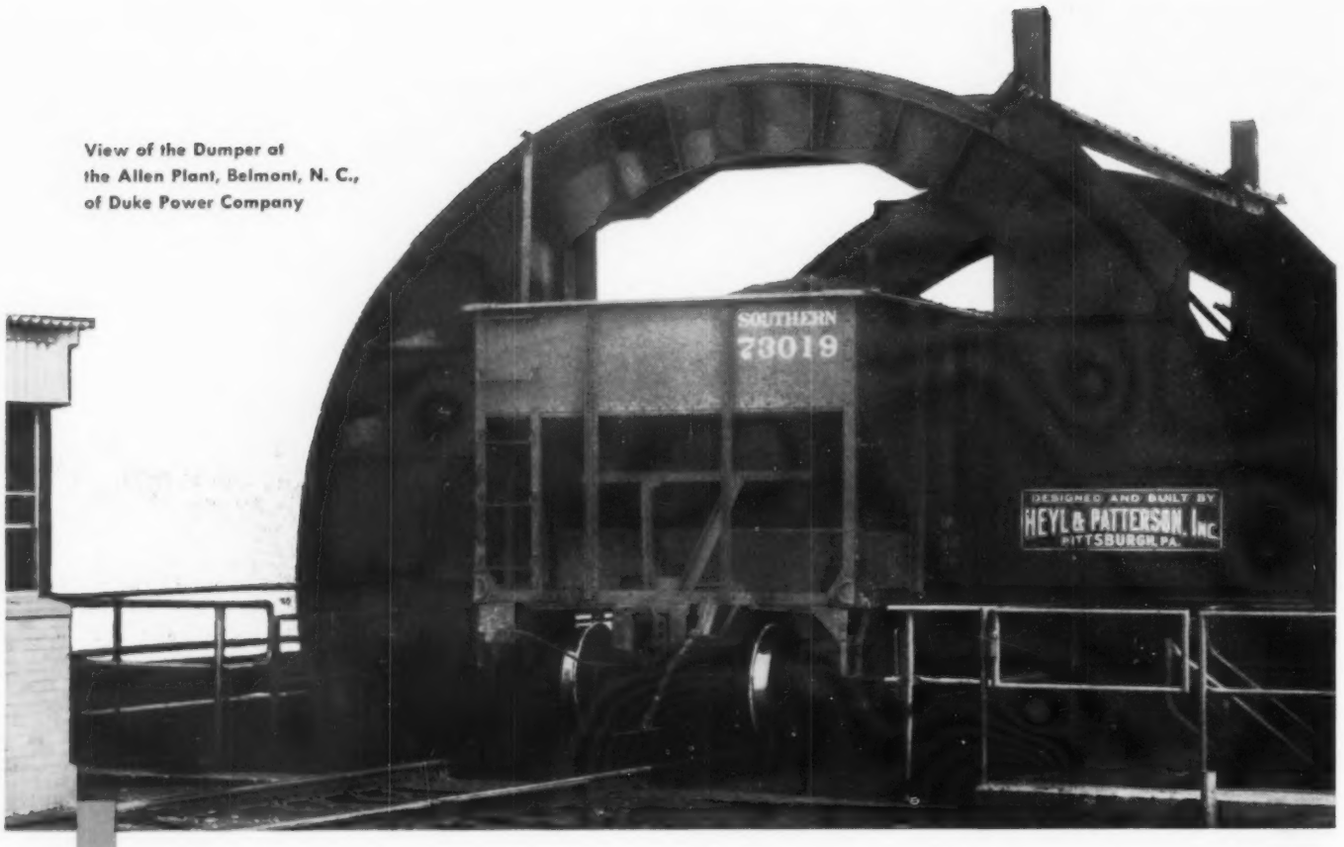
"ALCOA THEATRE"
Exciting Adventure
Alternate Monday Evenings



View of the Dumper at the Allen Plant, Belmont, N. C., of Duke Power Company

THE NEW H & P ROTARY CAR DUMPER

unloads Bulk Materials as fast as you can deliver cars

- Dumper is designed to rotate, dump and return to initial position in just one minute.
- Rotation can be stopped instantly at any position with car and platen firmly held in place.
- External and movable counterweights have been eliminated.
- Optional platen-mounted electronic scale is simple, accurate and economical.
- Optional car retarder on dumper permits economical and safe car spotting by dumper operator.

IT PAYS TO WEIGH AS YOU UNLOAD your bulk materials.

The new H & P Rotary Car Dumper, equipped with electronic scale platen (Patent Pending), unloads and weighs in one operation without requiring additional personnel or separate facilities.

Integral load cells permit instant weighing and light-weighing of car in compliance with National Bureau of Standards acceptance tolerance, and printing of weigh-tickets.

Exceptional accuracy and trouble-free performance are assured due to absence of wearing parts—no levers, fulcrums, etc.

For the most economical car weighing and dumping operation, investigate the new H & P Rotary Car Dumper!

MAIL COUPON TODAY FOR NEW DUMPER BROCHURE 957

HEYL & PATTERSON, INC., 55 Fort Pitt Blvd., Pittsburgh 22, Pa.

Please send me my copy of the H & P Dumper Brochure 957.

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Company_____

Address_____

City and State_____

Heyl & Patterson INC.

55 FORT PITT BLVD. · PITTSBURGH 22, PA.

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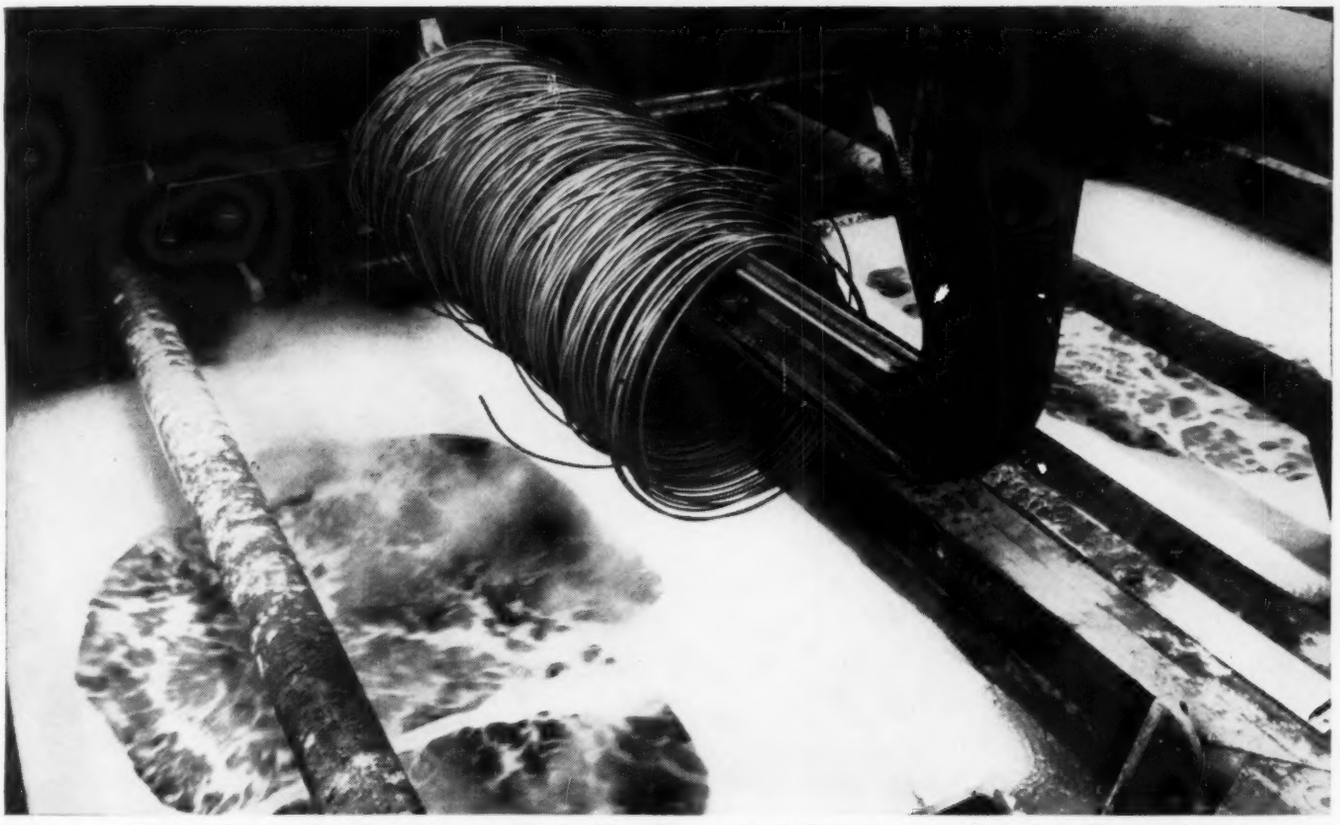


With 16 solution tanks, 6 flash-bakers, the Cleaning Line offers complete flexibility for treating low-carbon, alloy or spring wire and applying borax, lime or copper sulfate coatings.

Unique cleaning line at Donora Works speeds rod processing under Speedomax H control

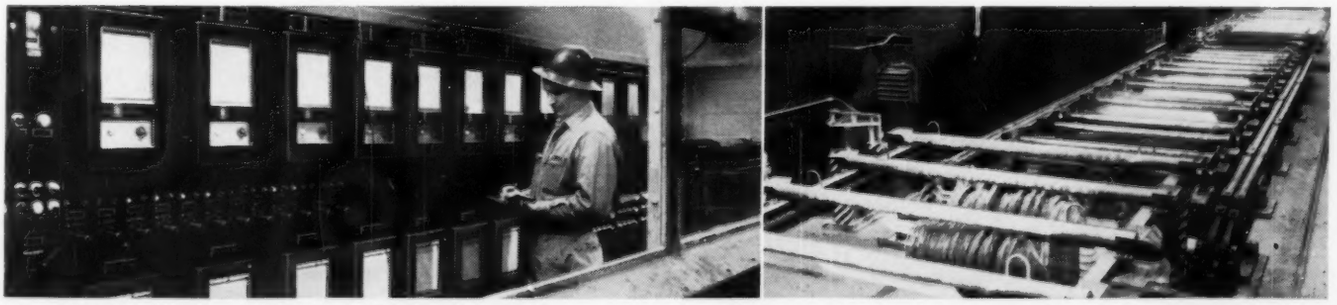
Clean, rinse, coat, bake . . . combining the flexibility of a batch operation with the smooth efficiency and high output of a continuous process. That's the performance of the rod-cleaning line at Donora Works, American Steel and Wire Division of U.S. Steel—a significant step in their major modernization and expansion program.

With 5000-pound pins of rods clock-card scheduled for processing through the line, there must be no delays — and Donora Works depends on Speedomax H to hold solution and flash-baker temperatures at optimum values, regardless of the load program.

Compact enough to save panel space, precise enough to suit exacting measuring and control requirements, sturdy enough to stand up to rugged shop conditions, this Speedomax H instrument is increasingly used for a variety of applications throughout steel plants, foundries, and the metal-working industry.

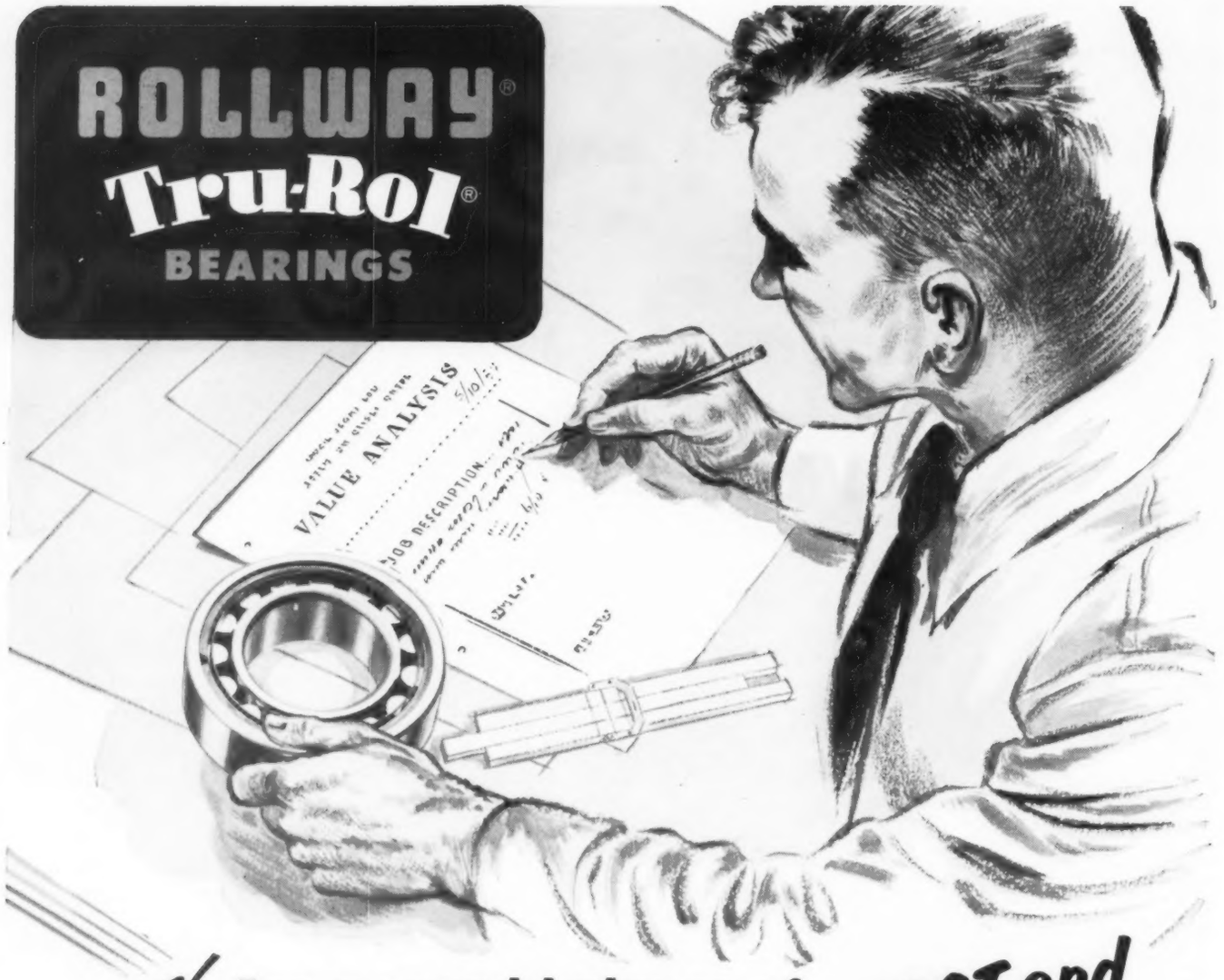
To investigate the potential of Speedomax H for expansion or modernization of *your* facilities, simply contact the L&N office near you, or write us at 4942 Stenton Avenue, Philadelphia 44, Pa.

LEEDS NORTHRUP
Instruments Automatic Controls • Furnaces



In this compact control room Speedomax H controllers keep steam-heated solution tanks at optimum temperatures, and monitor flash-baker temperatures for drying coated rods in minutes.

ROLLWAY®
Tru-Rol®
BEARINGS



For a sound balance of LOW COST and HIGH PERFORMANCE

When you need maximum precision bearings, buy them. They'll save you money. Rollway has them in all types and sizes.

But in hundreds of applications, maximum precision means *unused* precision. The speed, load and life-expectancy demands are not critical. For these spots, Rollway's Tru-Rol Bearings are engineered to give all that is required in performance at worthwhile savings in cost.

Maximum-Type Design and Construction Principles

The Tru-Rol segmented steel retainer is the strongest, most durable available in commercial-grade bearings. Its separator segments are formed to the curvature of the roller for true axial alignment. In combination with rollers crowned to provide equal load distribution, it withstands heavy shock and reversing loads over long periods.

For all the precision and performance you need and can use in non-critical applications, ask a nearby Rollway Service Engineer to brief you on Rollway Tru-Rol characteristics and versatility.

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SYRACUSE, NEW YORK

ENGINEERING OFFICES: Syracuse • Boston • Chicago
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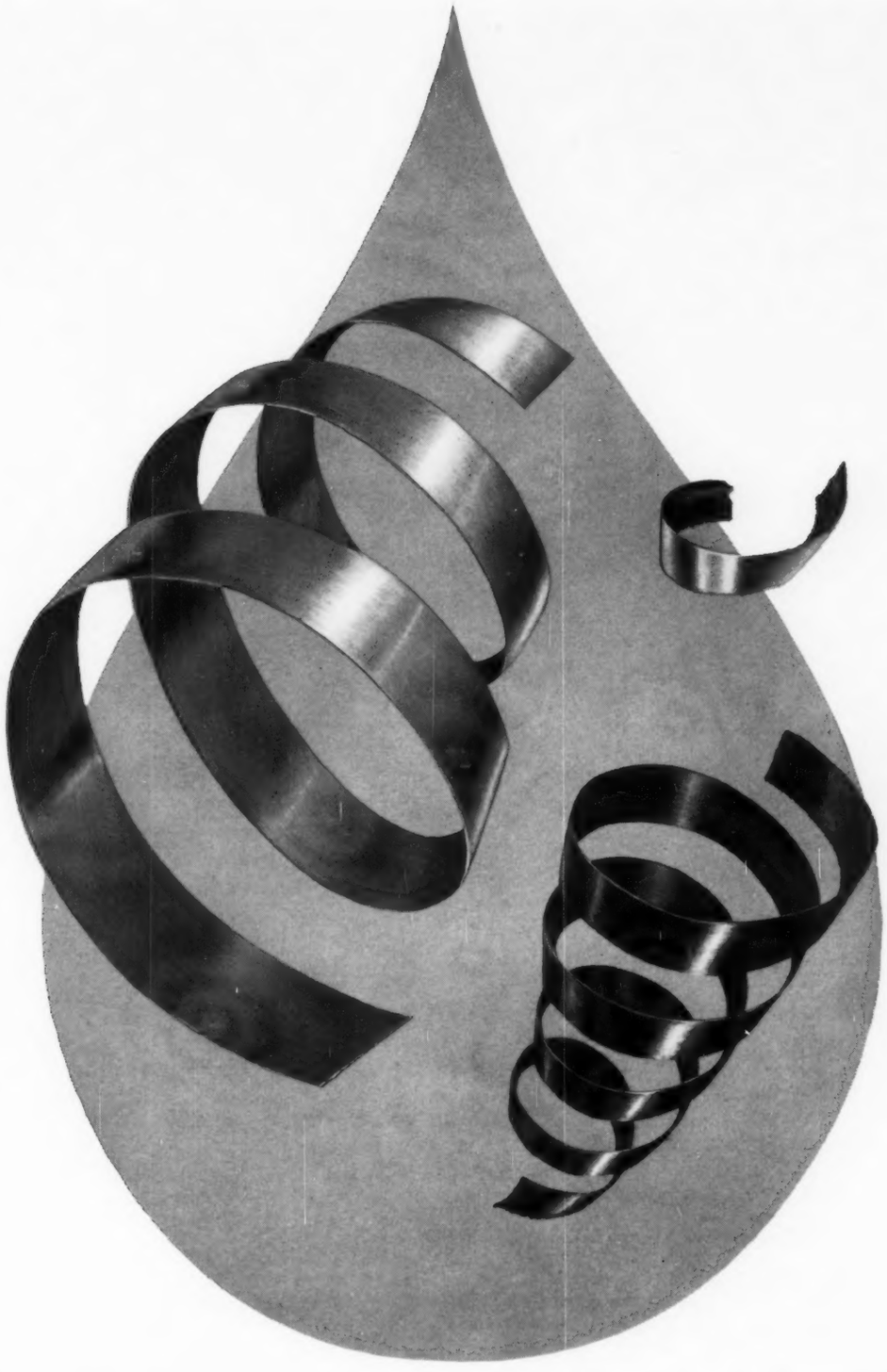

PUT YOUR SHOP "IN THE CHIPS" WITH NEW ATLANTIC CUTTING OILS

For complete information on these improved oils, contact The Atlantic Refining Company, 260 South Broad Street, Philadelphia 1, Pa., or any of the offices listed.

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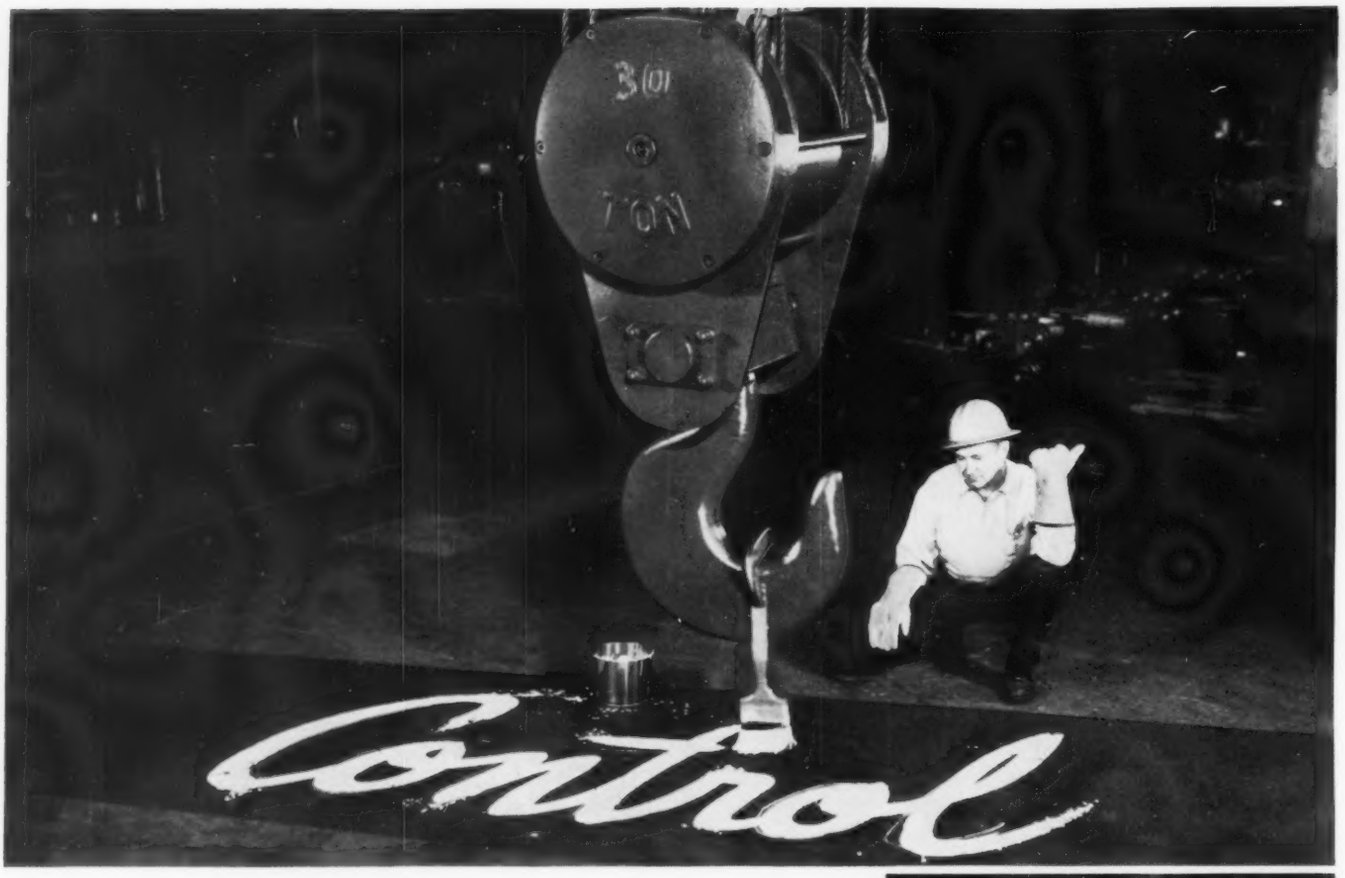


So Precise

you can write your name with a "Shaw-Box" Crane

You may never write your name with a paint brush clamped to a crane hook. We did it at our factory in Muskegon to prove you get absolute control of travel, traverse, lifting and lowering with a "Shaw-Box" Crane.

Total crane control demands more than sensitive controllers and the skill of the man in the cab. Every mechanical, electrical and structural component must contribute to precision operation. That is why "Shaw-Box" Cranes give full satisfaction in every respect.

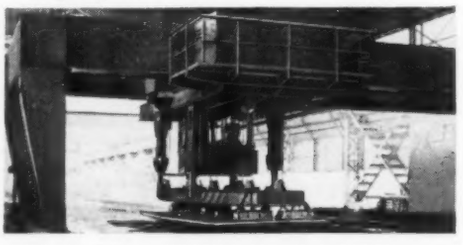
Turn to Shaw-Box for the crane you want

Shaw-Box produces cranes of *any* type and capacity to AISE standards or your own. Your particular materials handling problems come first. No traditional concepts of design hamper the development of the modern crane you want and must have for top efficiency, easy maintenance, power economy and complete safety.

Call in one of our engineers. He will gladly discuss your specifications and our standard AISE designs for 5 to 500-ton cranes. Your inquiry is invited.

Above: "Shaw-Box" ladle crane that handles 200 tons of molten steel in 90-ton ladle.

Below: "Shaw-Box" plate handling gantry with lifting magnets.



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"Shaw-Box"® CRANES

MANNING, MAXWELL & MOORE, INC.

SHAW-BOX CRANE & HOIST DIVISION

388 W. Broadway • Muskegon, Michigan

Builders of "SHAW-BOX" and 'LOAD LIFTER' Cranes, 'BUDGIT' and 'LOAD LIFTER' Hoists and other lifting specialties. Other Divisions produce 'ASHCROFT' Gauges, 'HANCOCK' Valves, 'CONSOLIDATED' Safety and Relief Valves, and 'AMERICAN' and 'AMERICAN-MICROSEN' Industrial Instruments.

In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

Jones & Laughlin Steel Corporation
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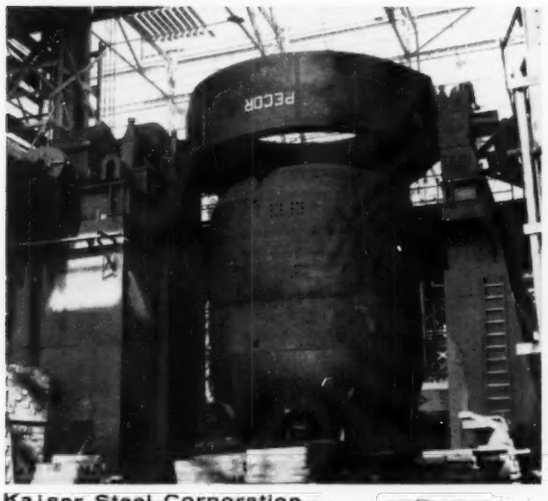

Kaiser Steel Corporation
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. . . MORE COMING!

In fact, PECor has fabricated all of the Basic Oxygen Furnaces that are in use or now being installed in America, including the major portion of the auxiliary equipment. When you have need of heavy machinery or equipment, rely on PECor's 75 years' experience in designing and fabricating for the steel, chemical, oil and other industries.

PENNSYLVANIA ENGINEERING CORPORATION

NEW CASTLE, PA.

OTHER STEEL PLANT EQUIPMENT WE BUILD

Blast Furnaces • Scrap Cars • Slag Cars
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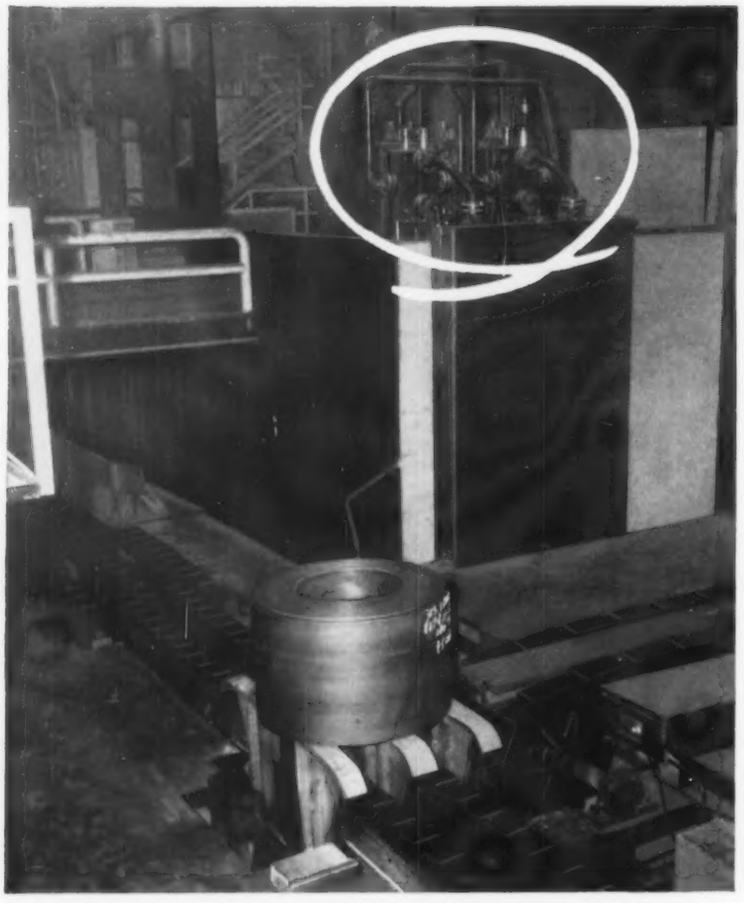
Hot Metal Mixers • Ore Transfer Cars
Ladles • Jack Cars • Ladle Transfer Cars
Ingot Cars • Mixer Cars • Thermo Metal (Bottle) Cars • Scale Cars

PECOR

3 YEARS OF TROUBLE-FREE SERVICE PROVE TAYLOR-EMMETT VALVES ARE RUGGED !

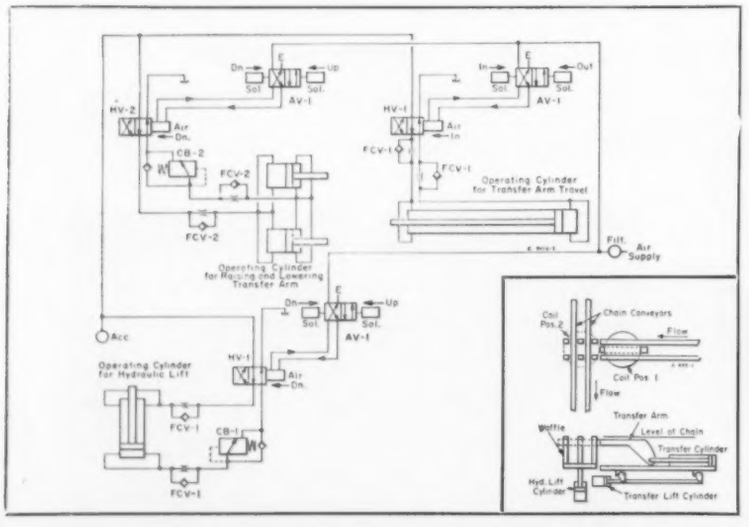


Taylor-Emmett valves (circled) operate high pressure hydraulic lift system. See drawing below for operating details.

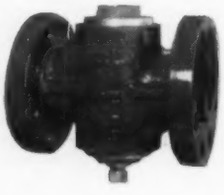
Large eastern strip mill re-orders Taylor-Emmett valves for conveyor system

Taylor-Emmett valves have given such fine service on the conveyor system shown at left that the company has specified them for the same system in their new 68″ strip mill. These valves operate a high pressure hydraulic direction-shifting device, lifting rolls of steel that weigh as much as 27,000 lbs. apiece. In three years of continuous service they have given top performance and required practically no maintenance.

Taylor-Emmett valves have proved themselves also in the plastics and rubber industries for compactness, interchangeability of parts, simplified construction. The result: practically no maintenance costs. They are now available through your experienced Taylor Field Engineer. Write for catalog to Taylor-Emmett Controls, Inc., Akron, Ohio or Taylor Instrument Companies, Rochester 1, N.Y.



Type E378† Counter Balance Valve
Full flow forward, no reverse flow until reverse pressure reaches preset value. Then reverse flow under continued pressure. 2000 psi.



Type E377† Flow Control Valve
Full flow forward, no flow or adjustable flow reverse. Both E377 and E378 are for oil or water service. 2000 psi.

†Now standard with new NEV-R-GRIND* Construction.
*Trade-Mark

Taylor Instruments MEAN ACCURACY FIRST

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To Users of Cutting Machines

AMERICAN MESSER CORPORATION WILL NOW HANDLE AND SERVICE THE WORLD-FAMED

MESSER CUTTING MACHINES

These widely-renowned oxygen cutting machines feature a distinctive construction and an engineered system of operation. With them, you can now achieve new standards of accuracy in precision workmanship. Write for full details!

NEW SALES MANAGER NAMED

Richard L. Deily has been appointed Sales Manager for Messer Cutting Machines. He is a graduate of Lehigh University. His 20 years' experience in the cutting machine and welding fields includes positions with some of the largest firms in the metal-working industry. May he consult with you on improved cutting techniques?

"THERE IS NO SUBSTITUTE FOR MESSER EXPERIENCE"

AMERICAN MESSER CORPORATION

Chrysler Building • 405 Lexington Avenue • New York, N. Y.

PRECISION CUTTING MACHINES...OXYGEN, NITROGEN, ARGON PLANTS

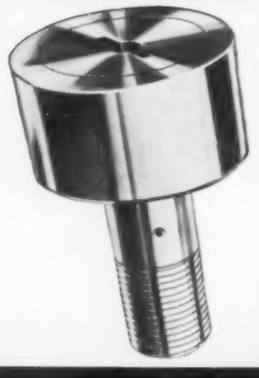
"WISH WE COULD GIVE SERVICE LIKE YOURS"

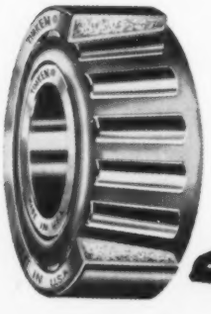
There's no doubt about it--customers certainly do appreciate service. And, when they get *exceptional* service, order after order, they frequently express their appreciation--like the Berry Bearing Company customer who said--"Wish we could give service like yours."

Giving all customers, both large and small, the ultimate in service has been a Berry Bearing policy since 1920. For each of those 38 years Berry has maintained its original basic objective of--*immediate delivery*--on every order, regardless of size.

To render such exceptional service Berry regularly stocks more than 50,000 types and sizes of bearings, bearing specialties, and transmission appliances...and...can make delivery anywhere in the Chicagoland industrial area--in approximately 27 minutes.

Like 16,846 other bearing users, you can get *everything* you require from Berry. So why not phone bearing headquarters now--for *anything* you need? You'll get exactly what you want... and...you'll get immediate delivery, too.





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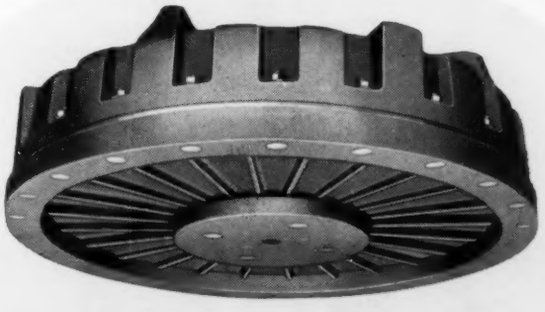
2 New Bolted LIFTING MAGNETS by EC&M

57" AND 66" DIAMETERS



New throughout, these EC&M **Type SB Lifting Magnets** have many improvements over previous-design bolted magnets. They are mechanically stronger, have improved coil construction, and high lifting capacity due to a better magnetic path. Tapered-head, through bolts simplify field replacement of worn pole shoes...permit quick access to coil.

Strap aluminum coil winding is firmly anchored by top-plate held by bolts and screws. Continuous welds seal coil spool in magnet case and make it water-tight. Welds are easily ground or chipped off for field removal of coil.

Coil-leads terminate in separate chambers, 180° apart. The magnet is freed of moisture and completely filled, through these two chambers, with self-polymerizing, insulating compound.

Chains, the same as used on large EC&M ALL-WELDED Magnets, are of 3-leg design with links of cast manganese steel terminating in a forged crane link for easy hook-on.

EC&M BOLTED MAGNETS complement the complete line of EC&M ALL-WELDED Magnets • For all the facts, Write for Bulletin 1300 SB

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
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News and Notes on...

Good Packing Practice

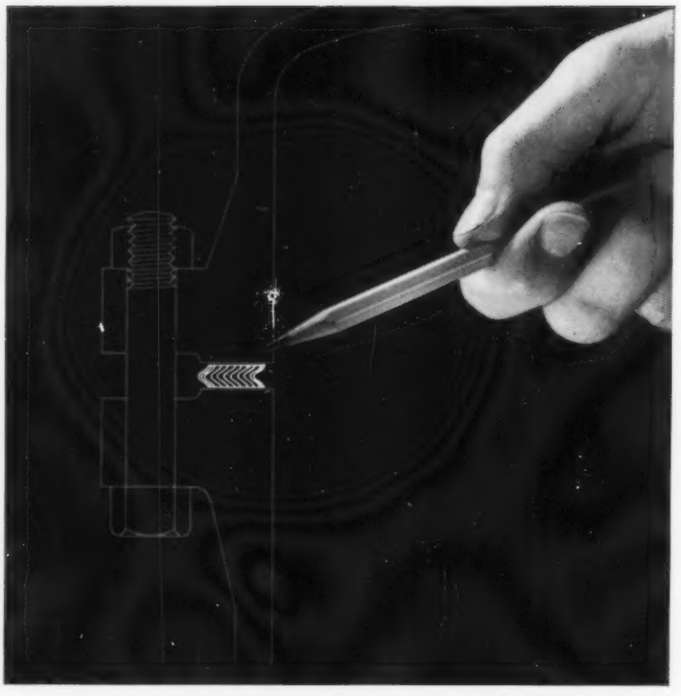
JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

Subject of the month: Selecting the Gasket

Question:

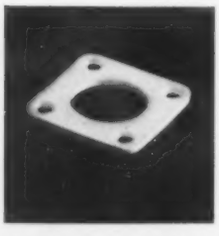
What are the important points to remember about gasket applications so we can avoid costly failure?



GASKET engineering is a complex study, but there are certain simple answers to this commonly asked question. Briefly, at least three variables must be considered. These are: 1. The available bolt force on the gasket. 2. Internal pressure and temperature. 3. The nature of the contained fluid.

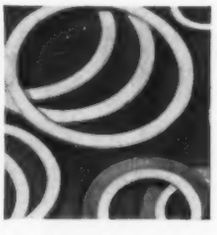
Starting with bolt force: it must be adequate to flow the gasket material and cause it to yield and seat effectively. Secondly: the bolt force must also always be sufficient to exceed the internal pressure and temperature forces that work against gasket closures. Finally: the gasket material must be impervious to the action of the confined fluid.

For service at low to medium temperatures and pressures: As a rule of thumb, if multiplying the operating pressure (psi) by operating temperature (°F) results in a product not exceeding 250,000, a quality "general service" type gasket can be used with complete safety. An outstanding gasket material for these operating conditions is J-M Service® Sheet #60 . . . a tough, durable compressed asbestos sheet. Service Sheet seals effectively against hot or cold water, steam, oils, mild acids and caustics.



If corrosive fluids are encountered: The best solution to the constant attack of chemicals and solvents is a gasketing material that is chemically inert. For this kind of service condition, Johns-Manville Teflon* Chempac® Gaskets are recommended. They are available in pure Teflon, low-flow (glass-filled) Teflon, Teflon-Asbestos, and in metal-Teflon combinations.

*TM for DuPont Tetrafluorethylene resin.



When extreme pressures and temperatures act on the gasket: If internal pressures reach 1200 psi or temperatures exceed 850°F, safe practice calls for a sturdy gasket that offers the high resiliency needed to follow expanding and contracting movements of flanges. For standard flange applications to 6,000 psi, you will find metal-asbestos, spiral-wound Goetze Spirotallic® gaskets most efficient. They offer high mechanical strength and resilience. Their special interlocking design and stainless steel construction is especially designed to effect and maintain a tight seal despite wide pressure and temperature variations.

To solve any sealing problems, call your J-M Packings and Gaskets field representative. He's equipped to give you information on new products . . . engineering and design advice. For information on any J-M Packings or Gaskets write Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

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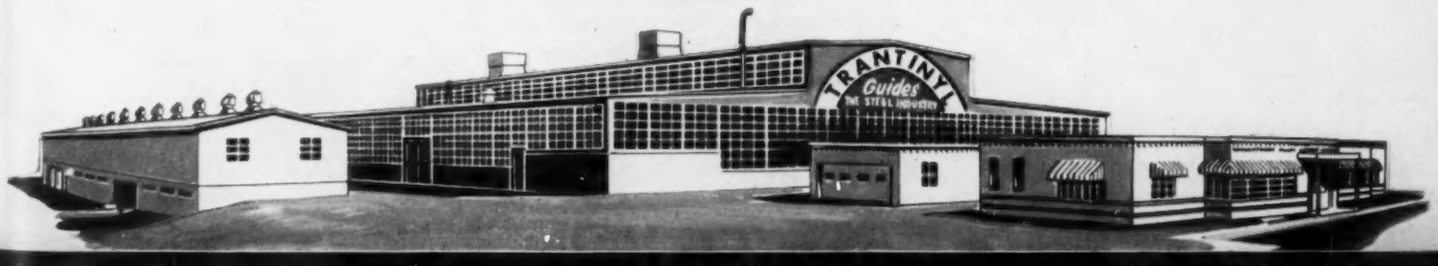

YOUNGSTOWN ALLOY CASTING CORP., • YOUNGSTOWN, O.

ROLLING MILLS: bar, hoop, strip, shape mill guides, and rollers. SEAMLESS TUBE MILLS: guide shoes, rolling mill plugs and rolls, piercer points, etc. ELECTRIC WELD TUBE MILL: forming rolls, planishing rolls, tool holders, etc. • STRAIGHTENING MACHINE GUIDES • HEAT RESISTING CASTINGS

Two 30 ton, 75 ft. span Bedford magnet cranes with 15 ton bucket auxiliaries working over the cinder yard — used as skull crackers in Detroit Steel Corporation's mill at New Boston (Portsmouth), Ohio.

Bedford Cranes are individually engineered

In steel mills, power plants and throughout heavy industry, wherever superior performance is *expected*, experienced owners are enthusiastically recommending Bedford cranes.

Further proof of the superiority of Bedford cranes is found in the high percentage of *repeat orders* from important owners through the years.

Built to the most modern standards and backed by more than 52 years of specialized crane building *and utilization* experience . . . Bedford cranes have won fame the world over for advanced design and for safe, smooth, dependable performance.

Available in all types and sizes . . . from 5 tons to 350 tons, and up, for all kinds of indoor and outdoor services . . . each Bedford crane is individually engineered and precision built for its specific application.

You are invited to consult a Bedford engineer on your next crane problem . . . with all the facts on the table we believe you too will make your next crane a Bedford.

(Write for complete catalog

SALES OFFICES

NEW YORK OFFICE: 310 Front Street, Hempstead, N. Y., Phone IVanhoe 3-1995

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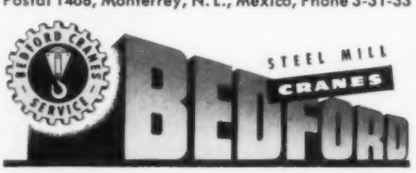
PITTSBURGH OFFICE: 1141 Oliver Building, Pittsburgh, Pa., Phone ATlantic 1-0136

AGENTS

The Hank Thurstin Company, 475 Acoma Street, Denver, Colo., Phone RAce 2-4689

Central Station Equipment Company, 2323 Aviation Highway, Tucson, Arizona, Phone MAin 3-2493

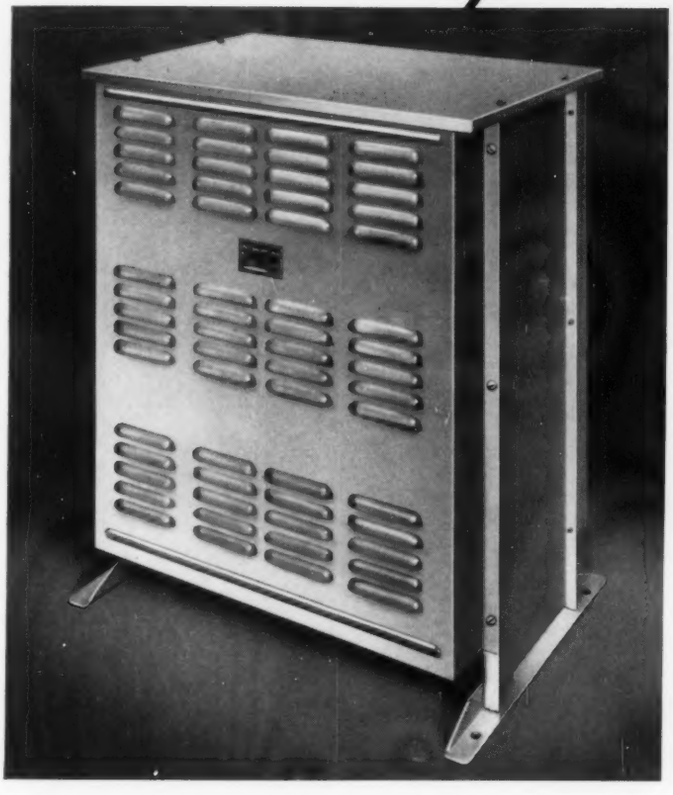
Promociones Industriales, S. A., Apartado Postal 1468, Monterrey, N. L., Mexico, Phone 3-31-33



BEDFORD FOUNDRY & MACHINE COMPANY, INC. · BEDFORD, INDIANA

POST-GLOVER RESISTORS...

Racked to suit the application!



Plain Racks without enclosure

Racks with solid or expanded metal

Racks with louvered or expanded metal

P-G the ORIGINAL Steel Grid Resistor

Made of steel and mica, nothing to break, plus P-G unique and exclusive grid design, these resistors afford maximum protection to vital equipment. They are rugged, nonbreakable, shock resistant, and have proved their merit in all kinds of service for over 20 years.

P-G Resistor Racks are available for all P-G Resistors in units from two to eight resistors high. If other than standard racks are more suitable, special racks can be furnished to suit the application. Ventilation is achieved through louvered or expanded metal panels as desired, both easily removable with only a screw driver. P-G Racks may be shipped complete with resistors mounted, with or without enclosure, or knocked down to save shipping space. For further data about P-G Resistors and Racks, write us of your needs.

The Nonbreakable Steel Grid Resistor

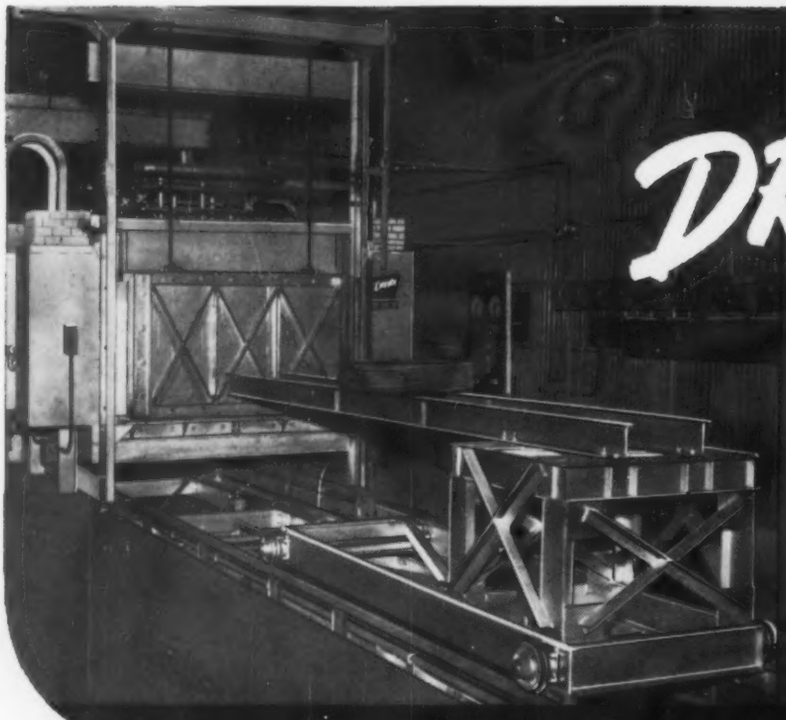
P-G

ESTABLISHED 1892

THE **POST-GLOVER** ELECTRIC COMPANY

OFFICE and FACTORY—Kenton Lands Road, Erlanger, Kentucky

MAILING ADDRESS—Box 709, Covington, Kentucky



DREVER

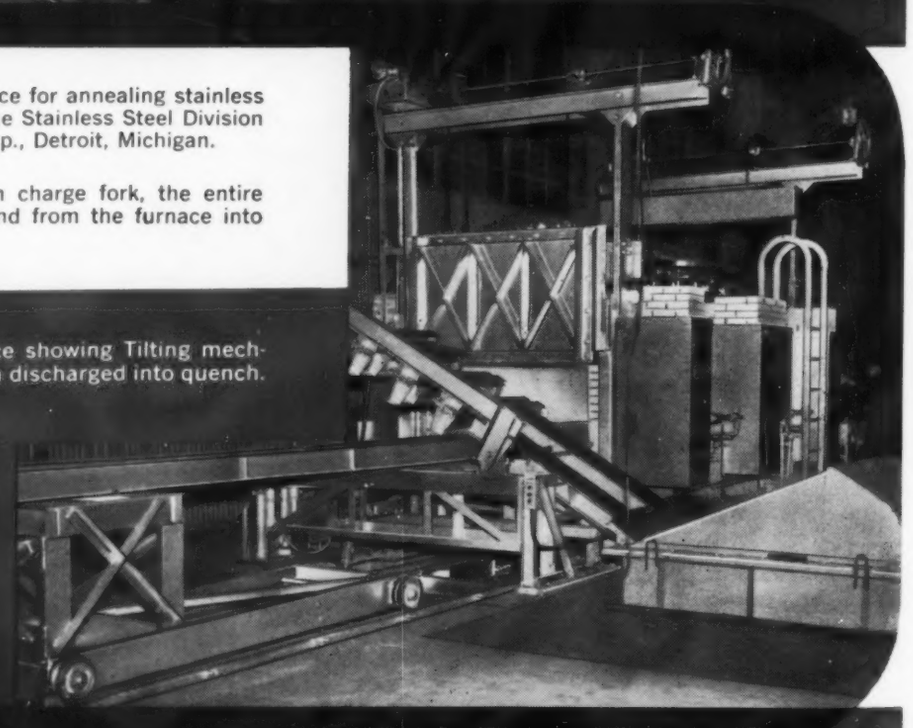
Stainless Wire Coil Annealers

Charge end of a Drever furnace for annealing stainless steel wire coils installed at the Stainless Steel Division of Jones & Laughlin Steel Corp., Detroit, Michigan.

After operator places coil on charge fork, the entire operation into the furnace and from the furnace into the quench is automatic.

Discharge end of furnace showing Tilting mechanism after coil has been discharged into quench.

Two quenches are supplied; water quench for 300 series and oil quench for 400 series.



Drever's gas-fired coil annealing furnace is designed to handle (4) 250 lb. coils of wire per hour. Coils vary from 36" to 48" O.D. in size and from 200 to 250 lbs. in weight.

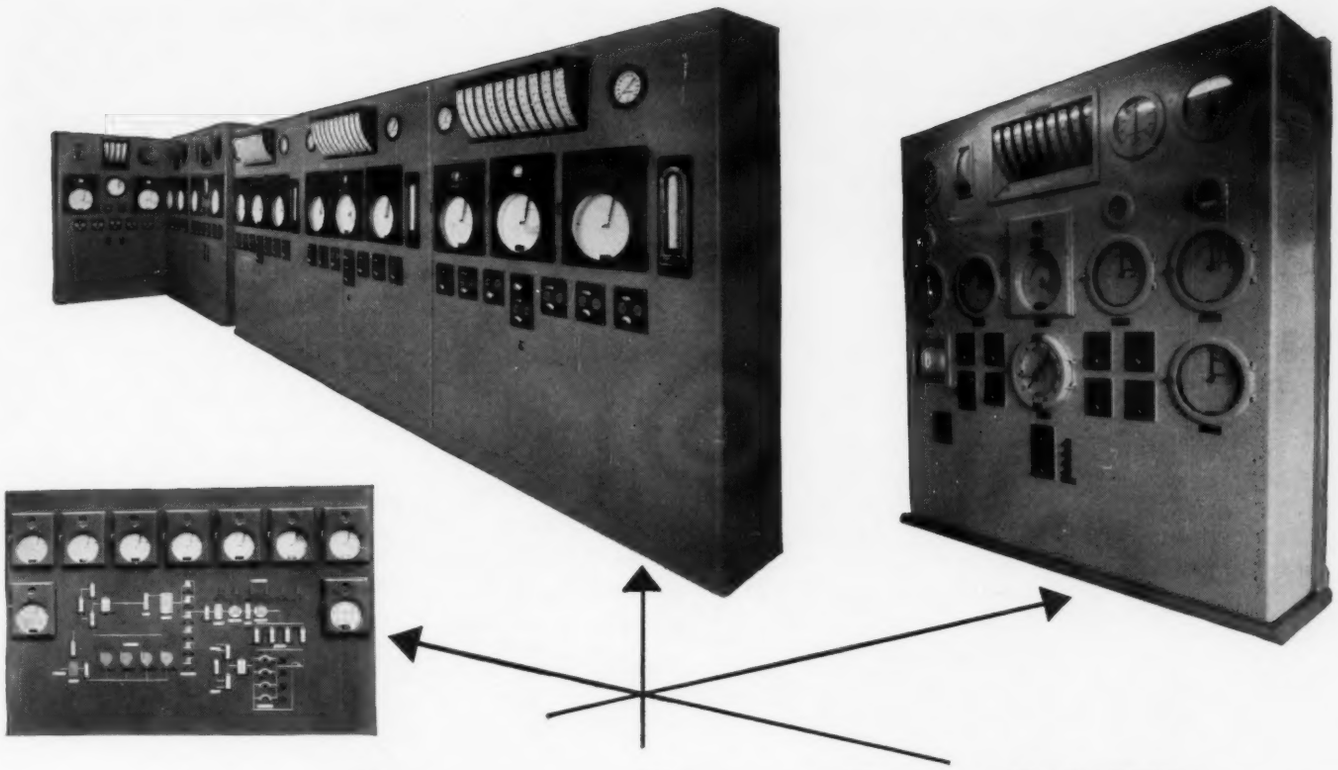
Uniform and rapid heating of coils is accomplished with a minimum of scale formation.

Consult Drever engineers on your stainless wire, rod, bar, sheet, plate and strip heating problems.

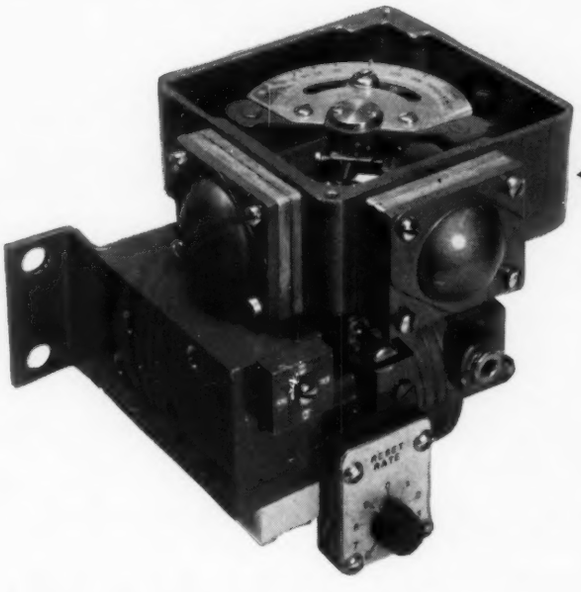
DREVER COMPANY

RED LION ROAD 60 PHILMONT AVE. BETHAYRES, PA.

37



Base Any Of These



ON THIS

For accurate, efficient, dependable control systems— REPUBLIC'S NEW TYPE "VC" PNEUMATIC CONTROLLER

Here is an all purpose null-balance-vector controller for use with any pneumatic transmitter. Its proportional band ranges from 2% to 500% *without changing parts,* for quick adaptation to changes in process requirements. Especially important in high-precision control, Republic's Type VC has exceptional sensitivity and a narrow dead band (less than 0.05%). Its high capacity non-bleed pneumatic amplifier consumes little air, keeps output ample. A selector block permits reverse or direct action; local or remote pneumatic set point optional.

Companion instruments—using an identical null-balance-vector "heart"—include differential pressure, temperature and pressure transmitters . . . ratio, totalizing, multiplying, squaring and square - root - extracting relays. Many parts are interchangeable among the instruments in this "family". Besides reducing spare parts inventory, the similarity of components simplifies the task of training personnel.

Let a Republic engineer show you how these instruments can help to achieve accurate, efficient, dependable control systems. Republic Sales Offices are located in principal cities throughout the U.S.A. and Canada.

REPUBLIC FLOW METERS CO.

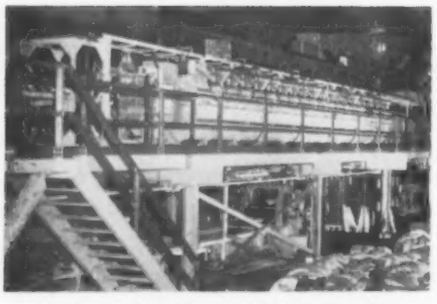
Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto
Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

if you perform any of these operations

Aging
Annealing
Aluminum Brazing
Aluminizing Strip, etc.
Billet Heating
Brass Brazing
Bright Annealing
Bright Hardening
Carbon Restoration
Carbonitriding
Carburizing, Gas, etc.
Controlled Atmosphere
Copper Brazing
Enameling • Forging
Galvanizing Strip, etc.
Glass Heat Treating
Hardening and Drawing
Homogenizing
Malleablizing
Nitriding
Normalizing
Scale-Free Hardening
Sintering
Silver Soldering
Special Atmosphere Treatments
Spheroidizing
Solution Heat Treating
Strip Coating—Any Process
Stress Relieving
Quenching

we can build an EF PRODUCTION HEAT PROCESSING FURNACE

to fit your specific requirements

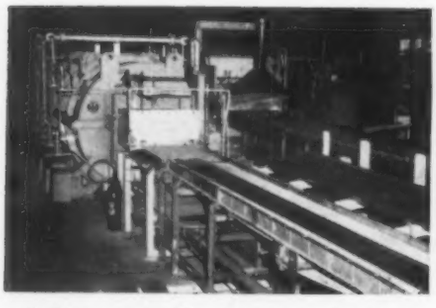


Large capacity EF gas fired furnace bright annealing stainless strip. We build them electrically heated or gas fired for wide or narrow strip, for single or multiple strands.

Backed by over 40 years of practical furnace building experience and thousands of successful fuel fired and electric furnace installations, EF engineers are in position to design and build just the size and type of equipment you need for handling any product or production, or for any heat treating or processing requirement.

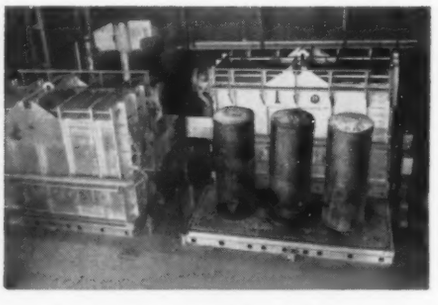
Submit your production furnace problems to experienced EF engineers — it pays.

EF THE ELECTRIC FURNACE CO.
GAS FIRED, OIL FIRED AND ELECTRIC FURNACES FOR ANY PROCESS, PRODUCT OR PRODUCTION
Salem - Ohio
Canadian Associates • Canefco Limited • Toronto 13, Canada



Stainless steel tubing in various diameters and lengths is bright annealed continuously in this EF gas fired furnace. Other types available for wire or strip.

EF direct gas fired special atmosphere forced circulation single-stack circular bell type annealing furnaces each accommodates charges up to 45,000 lbs.



Part of another installation of large EF gas fired three-stack rectangular bell type forced circulation special atmosphere annealers—available for strip or wire.

NATIONAL brushes cured this balky power shovel...and helped 14 other mines!

M. B. INMAN

Constant brush trouble on a power shovel led this mining company to call in "National" Carbon Brush Man M. B. Inman. His recommendation paid off so promptly he was asked to check recurring exhaust fan trouble at another company-mine.

Here Burt recommended brushes that could ride the fans' high speed commutators without burning. Next, the company asked Inman to survey all of its brush-using equipment. RESULT: a plan that simplified ordering, insured good performance and reduced inventories *by stopping duplicate ordering.*

The "National" Brush Data Survey idea soon spread to every company-mine in the state... then to all mines in the neighboring state—15 mines in all. This is typical of the service provided by your "National" Brush Man. Call him today, or write National Carbon Company, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, New York.

UNION CARBIDE

"National", "N" and Shield Device, and "Union Carbide" are registered trade-marks of Union Carbide Corporation

NATIONAL CARBON COMPANY • Division of Union Carbide Corporation • 30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. *In Canada:* Union Carbide Canada Limited, Toronto.

Okocord flexible cords have proved their ruggedness and dependability on tough, demanding applications like this open hearth charging buggy that must operate around the clock.

Heat and abuse . . . no problem for Okocord portable cables

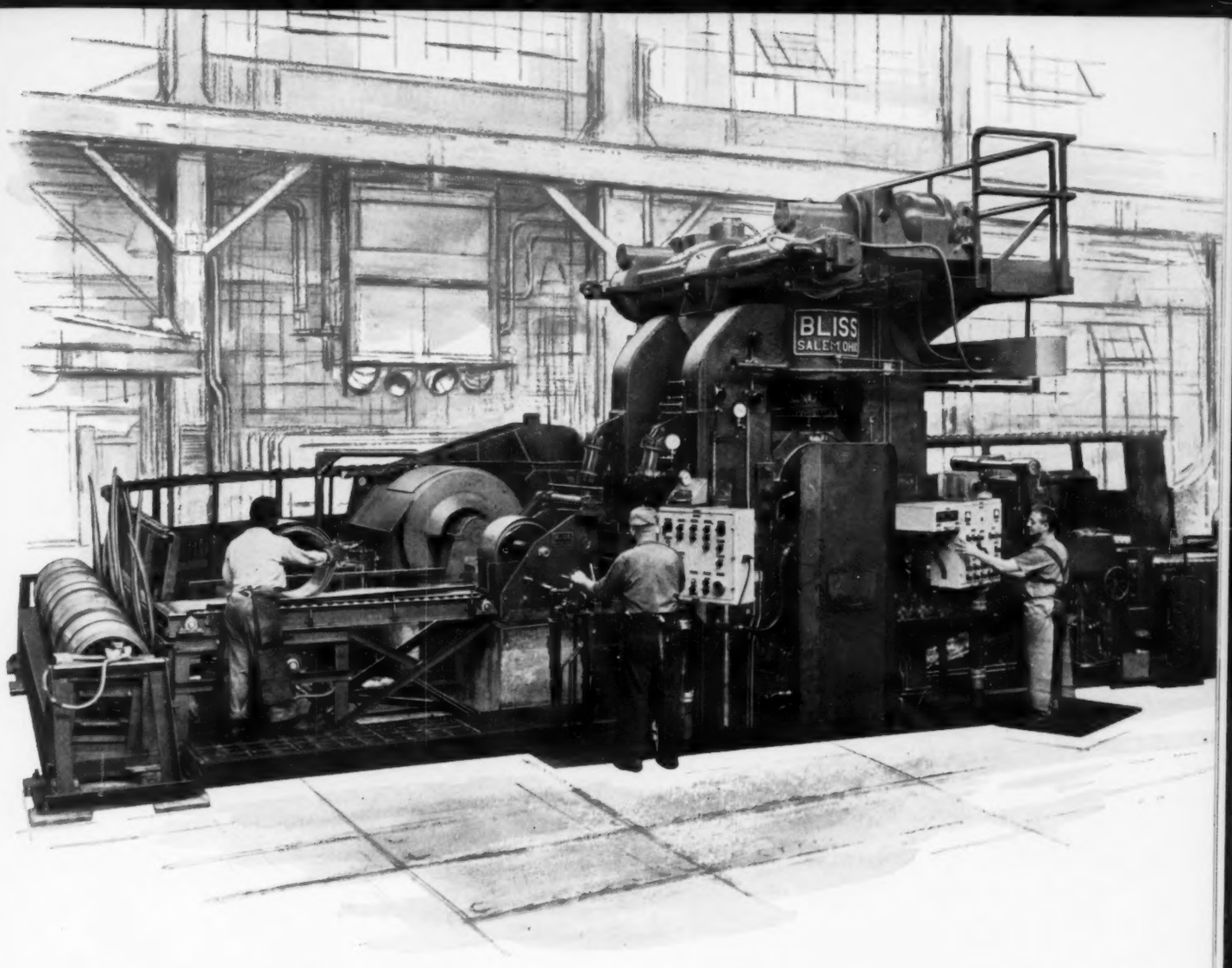
The charging machine above is controlled by Okocord flexible cables. They have to withstand constant heat and abrasion. And they're wound and unwound about a small reel every time the charging arm enters the furnace—literally hundreds of times every day.

Okocords are used for tough applications like this because they've been proved in service in steel mills . . . and in every other kind of plant. The rugged Okoprene sheath has superior flame resistance . . . plus the tire-tread toughness and extra flexibility that come from being cured in a continuous metal mold. The Okocord conductors have maximum flexibility because they are made of fine copper wires twisted together with a short lay.

Add to this Okocord's carefully-selected, tough, heat-resisting insulation and Okonite's reputation for superior engineering and manufacture . . . and you'll see why you should specify Okocord for every tough portable cord and cable application. Get complete details from your Okonite salesman or write for Bulletin IS-451. The Okonite Company, Passaic, N. J.

where there's electrical power . . . there's **OKONITE CABLE**

4903



HOW TO ROLL MORE FOR LESS:

replace three-and-a-half old-timers with one really modern mill

The recently-completed modernization program at H. K. Porter Company's Riverside-Alloy Metal Division has doubled the plant's capacity of specialty nonferrous alloys with essentially the same work force.

A central unit in the modernization is the Bliss 4-high intermediate mill shown here. According to Riverside, this single new mill provides greater production than the three old mills it replaces—a fourth old mill is still used to some extent, hence the three-and-a-half figure. Equipped with a run-around roller conveyor, the new mill coils metal on the first pass from ½-inch bars; returns the coils automatically to the entry side for further passes. Former practice was to roll flat for four or five passes before coiling.

Riverside reports that the new equipment will pay for itself in the short space of a few years. It's an outstanding example of the way a well-planned improvement program... plus Bliss rolling mill equipment... can bring new economy and efficiency to metal rolling. For other examples, write us today for a complimentary copy of our new 84-page Rolling Mill Brochure.

BLISS
SINCE 1857

Bliss is more than a name . . . it's a guarantee

E.W. BLISS COMPANY, Rolling Mill Division, Salem, Ohio

Subsidiary: The Matteson Equipment Company, Inc., Poland, Ohio

This idea was perfected by Wheelabrator® pioneering

Just twenty-five years ago, a wheel first became a "Wheel-abrator". Mankind's greatest invention . . . the wheel . . . was turned to a new purpose. A new idea gave industry a better way to blast clean materials — without air.

Wheelabrator's policy of pioneering leadership perfected this process. And with it was born an entirely new industry of which Wheelabrator Corporation is the principal supplier and the leading contributor to its advancement.

The same pioneering philosophy led Wheelabrator to adapt this revolutionary process to a multitude of new and unique uses. And the list of applications continues to grow as Wheelabrator's research probes and explores to find better ways to solve industry's blast cleaning and finishing problems.

WHEELABRATOR
CORPORATION

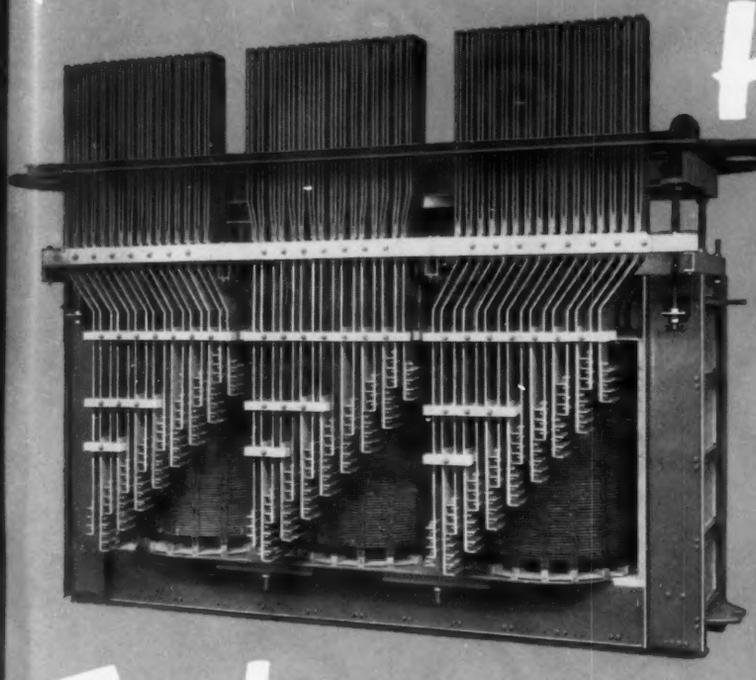
396 South Byrkit Street Mishawaka, Indiana

Canadian Offices: Scarborough (Toronto) – Montreal

50 YEARS OF PROGRESS
WHERE PIONEERING LEADERSHIP INSURES PERFORMANCE

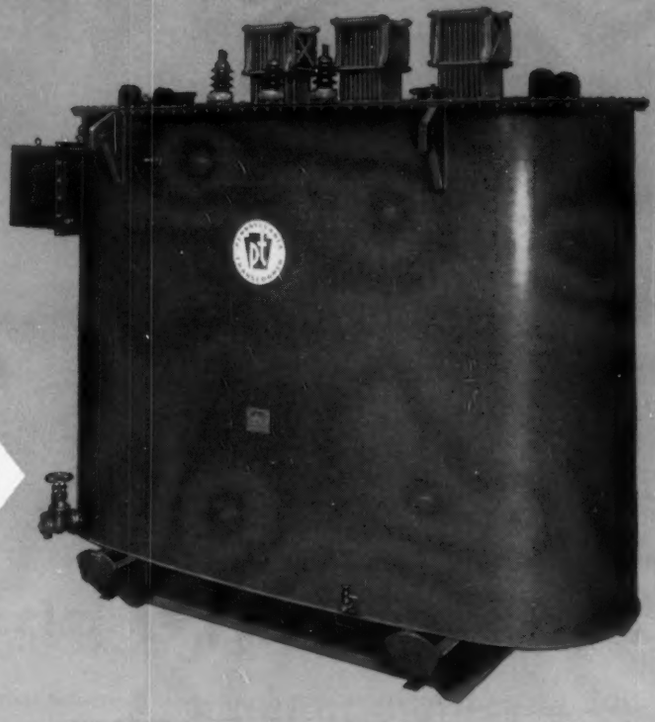
World's largest manufacturers of airless blast equipment and steel abrasives.

what are your FURNACE TRANSFORMER requirements?



High Current?

The **82,000-ampere** low voltage line current for which this Pennsylvania Furnace Transformer is designed is one of the highest current ratings ever provided for a furnace transformer in this country. The transformer is rated at 16,000/21,300 kva. High voltage: 13,200△ volts. Low voltage: 250△ volts with a full-capacity tap range in 10-volt steps down to 150 volts.



Fast Delivery?

Only **20 calendar days** were required to build and ship this 25,000-kva Pennsylvania Furnace Transformer. Even the *promised* shipping period of four weeks had looked like excellent service to the West Coast steelmaker—and by cutting this time by one-fourth, Pennsylvania saved the customer several days of costly downtime for the electric furnace involved. High voltage: 6,600 volts. Low voltage: 450 to 300 volts.

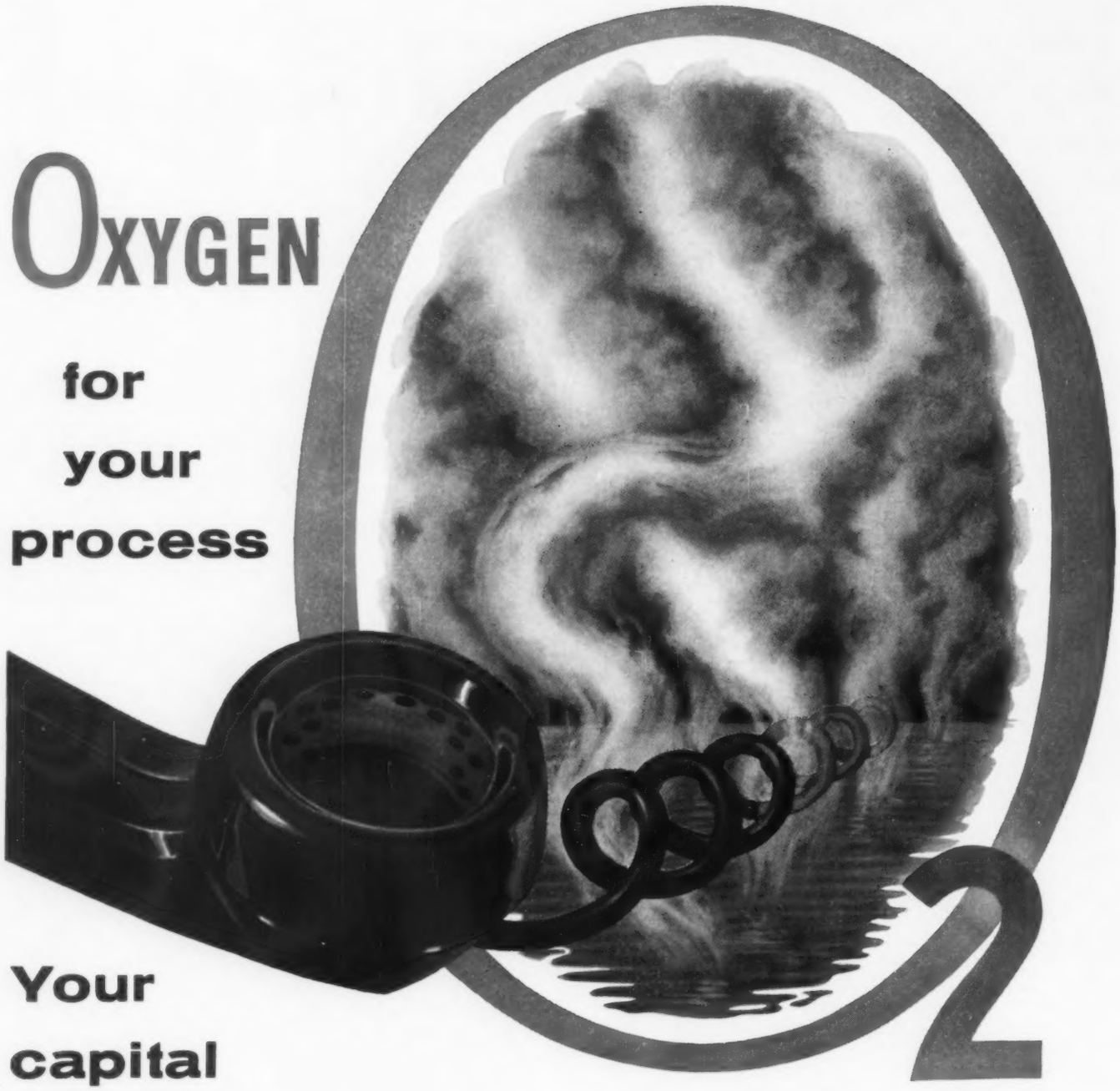
OF COURSE . . . it takes a lot of "everyday" know-how to accomplish the unusual with furnace transformers. Pennsylvania has established a nation-wide reputation for tackling and solving the most difficult problems in this highly demanding field . . . and not-so-incidentally, has designed and built virtually every size and type of furnace transformer now in use: from 250 through 25,000 kva, and from 3175 through 82,000 amperes. To put this furnace transformer experience to work for you, contact Pennsylvania Transformer Division, McGraw-Edison Company, Box 330, Canonsburg, Pa.

PENNSYLVANIA pt PENNSYLVANIA TRANSFORMERS **FURNACE TRANSFORMERS**

McGRAW EDISON

OXYGEN

for your process



Your capital investment: a phone call to LINDE

All the oxygen your process requires can be supplied economically by LINDE. You can have it in liquid or gaseous form, when and where you want it. You get the exact amounts you need in an unfailing, continuous supply. You invest nothing, and you pay only for the oxygen you use—at a contract price from LINDE.

To serve your pilot plant, LINDE will install the oxygen supply system best suited to your needs. For your laboratories or bench-scale testing, LINDE can supply liquid or gaseous oxygen by the cylinder, or just a flaskful.

Where large quantities are required, your LINDE oxygen may come from special tank cars or trucks, or directly from an on-site oxygen plant built, operated, and maintained by LINDE. Your supply will be backed up by LINDE's widespread distribution system, assuring you of a continuous flow.

Whatever your requirements, take advantage of LINDE's more than 50 years of experience in producing and supplying oxygen, nitrogen, and argon to industry. Write or phone your nearest LINDE office today! LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

When you need Oxygen—call LINDE!

Linde TRADE-MARK

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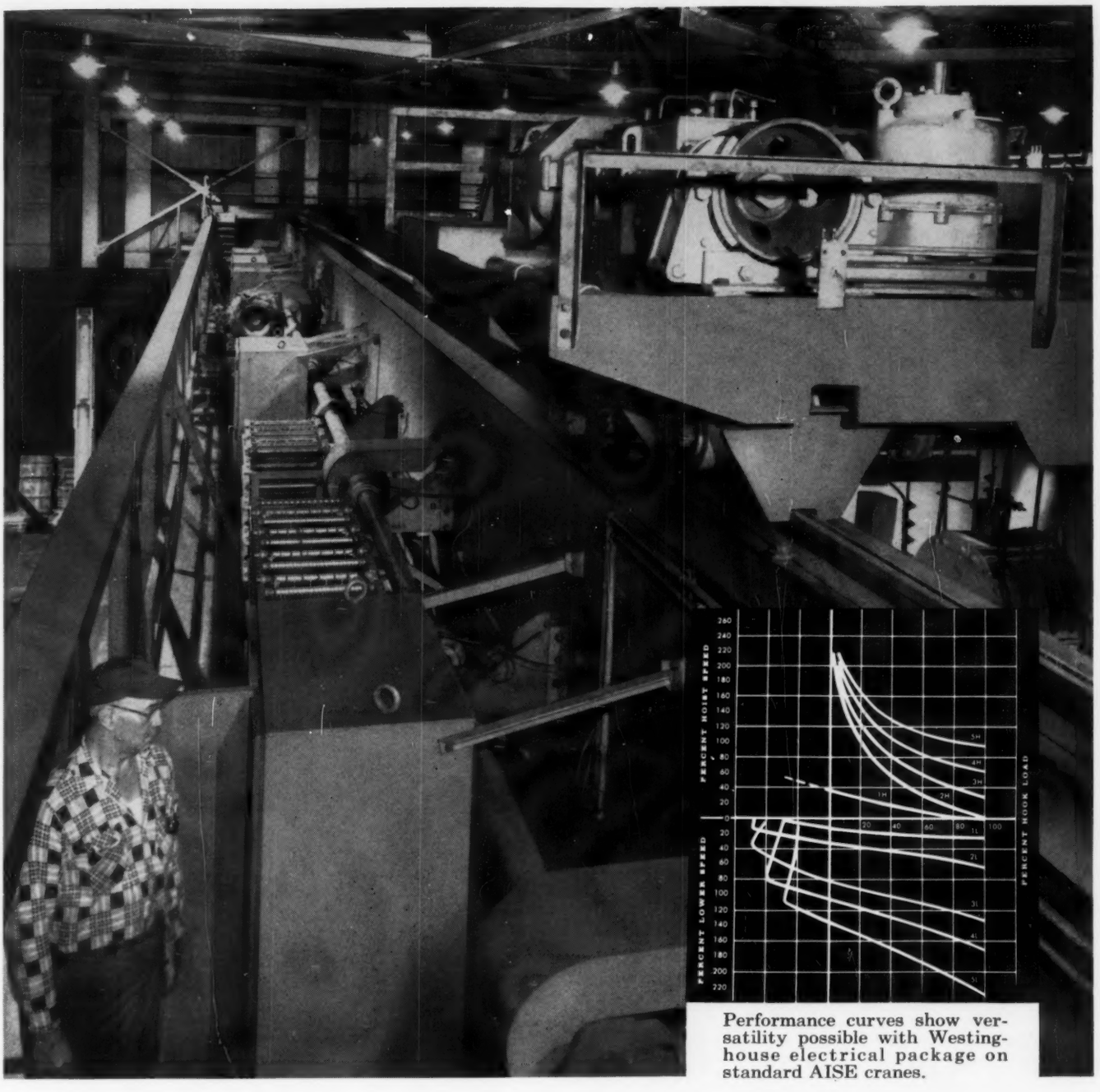


Performance curves show versatility possible with Westinghouse electrical package on standard AISE cranes.

Westinghouse electrical package for AISE cranes means better performance... less maintenance

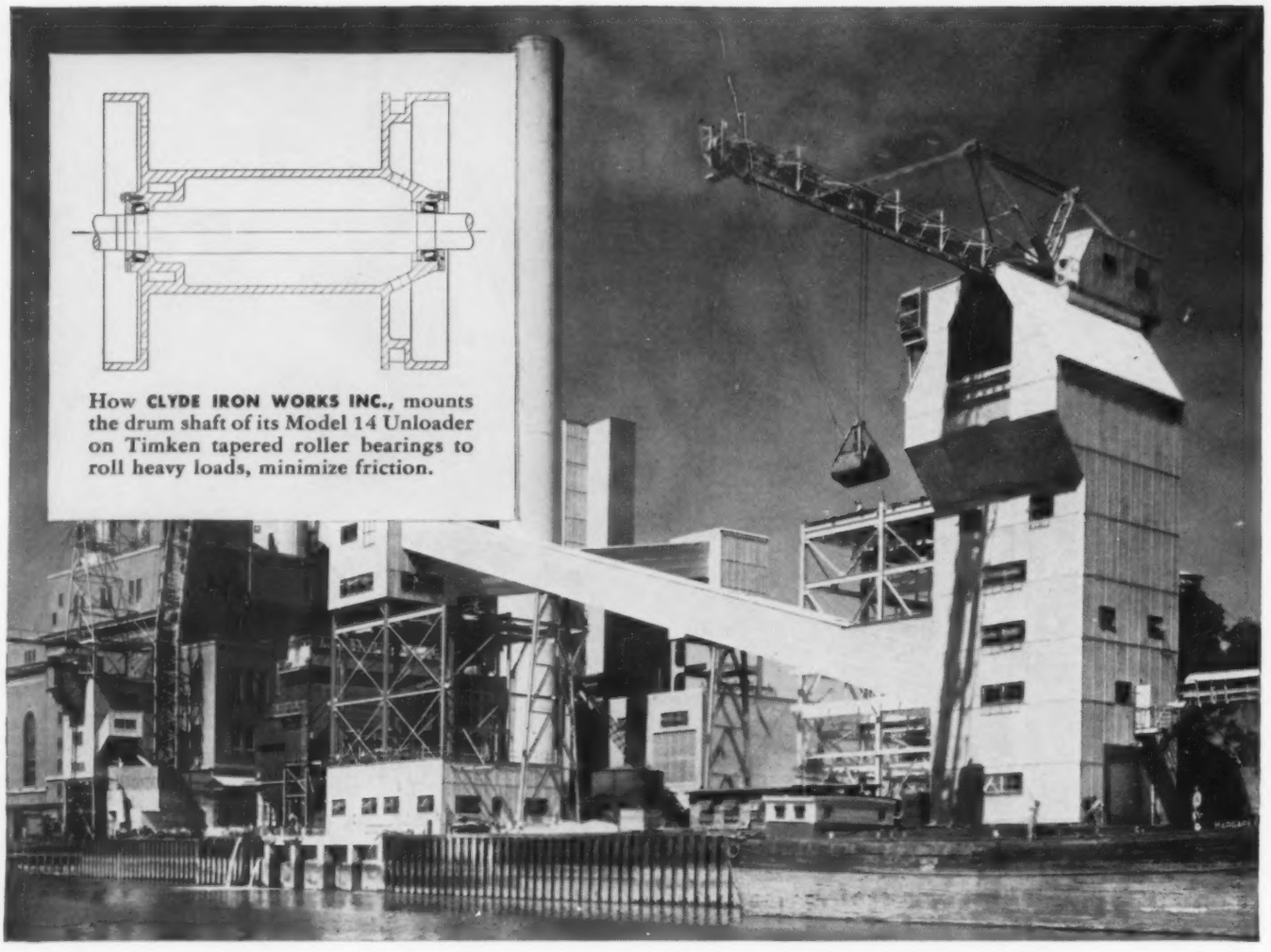
MOTORS • CONTROL • BRAKES • GEARING

Westinghouse 600 Series silicone mill motors, self-adjusting brakes and gearing, plus front-connected and -wired front-accessible control, meet rigid AISE standards . . . assure top performance and minimum maintenance because they are designed to work together.

When you are considering new or replacement crane drives, look to Westinghouse for the exact system needed. For complete information, contact your Westinghouse sales engineer. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania.

J-96122

YOU CAN BE SURE... IF IT'S Westinghouse



How **CLYDE IRON WORKS INC.,** mounts the drum shaft of its Model 14 Unloader on Timken tapered roller bearings to roll heavy loads, minimize friction.

Clyde Unloader unloads 250 T.P.H. as 22 Timken® bearings roll the loads

UNLOADING coal barges at a 250 ton-per-hour rate puts terrific loads on the hoist drums and sheaves of the Clyde Model 14 Unloader. To roll the heavy loads steadily and smoothly, Clyde engineers mount the three drums and eight sheaves on a total of 22 Timken® tapered roller bearings.

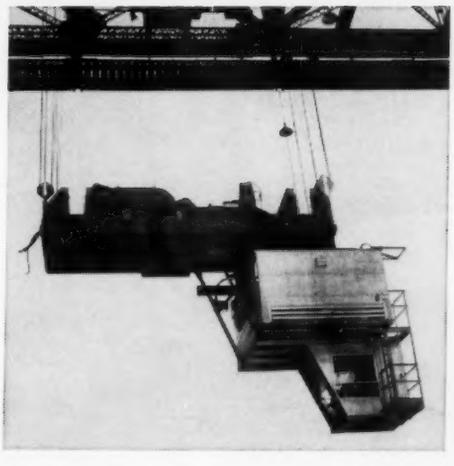
Timken bearings have *extra* load-carrying capacity. That's because of full-line contact between their rollers and races. And the tapered construction of Timken bearings lets them take both radial and thrust loads in any combination. Because they're geometrically designed and precision-manufactured to roll true, Timken bearings practically eliminate friction. They reduce power loss, last longer; keep the drums and sheaves working smoother, steadier, with less maintenance.

To get all these advantages when you buy or build machines, specify Timken tapered roller bearings. Look for the "Timken Bearing Equipped" label. It's your symbol of Better-ness. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

TIMKEN TAPERED ROLLER BEARINGS ROLL THE LOAD

TRADE-MARK REG. U. S. PAT. OFF.



you CAN double ore bridge capacity without production shutdowns!

Operating records of several steel companies prove that you can add greater ore handling capacity practically and economically. In recent years, these companies installed Dravo replacement man trolleys on their existing bridges and immediately realized these benefits: Increased free-digging hourly tonnage rates (in one case, doubled), faster operating cycles, no blast furnace shutdowns since installation took less than 24 hours! Most important, this greatly improved performance was obtained at ⅛ the cost of a new bridge.

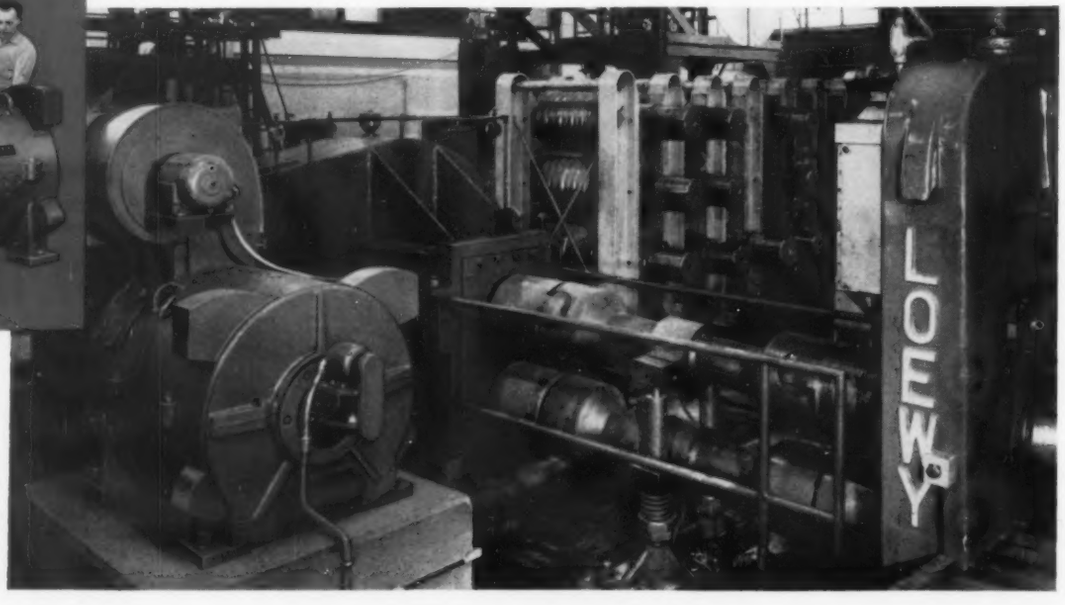
Take a close look at your present ore bridge operations—then let a Dravo engineer show you the big difference a Dravo replacement man trolley will make in its performance. For full details on this—and other time-saving, cost-cutting Dravo material handling systems—call, wire or write Dravo Corporation, Neville Island, Pittsburgh 25, Pa. SPalding 1-1200.

DRAVO
CORPORATION

ELLIOTT C-W 620 FRAME MOTOR

The Elliott 620 frame mill motor (above) in protected, forced-ventilated enclosure.

This Elliott C-W 620 frame motor (below) with a continuous rating of 350 hp, drives a two-high reversing mill. Enclosure is protected, forced-ventilated. Note ready access to commutator, even with top-mounted blower. Air vents are screened.



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IRON PIPE CO. • AMERICAN SMELTING & REFINING • AMERICAN STEEL & WIRE CO. • ARMCO STEEL CORP.
ATHENIA STEEL CO. • BABCOCK & WILCOX TUBE CO. • BETHLEHEM PACIFIC COAST STEEL CO. • BETHLEHE
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STEEL CO. • WHEELING STEEL CORP. • WYMAN GORDON COMPANY • YOUNGSTOWN SHEET & TUBE

For 54 years....

Elliott Mill Motors have served the nation's leading metal producers

ELLIOTT'S NEWEST MILL MOTOR

delivers greater power . . . greater overload capacity

In 1904, Crocker-Wheeler introduced the *first* "Mill-type" motor . . . insulated with asbestos and mica . . . "bull strong." In the succeeding 50 years, C-W repeatedly introduced bigger, tougher mill motors to keep pace with the steel industry's needs.

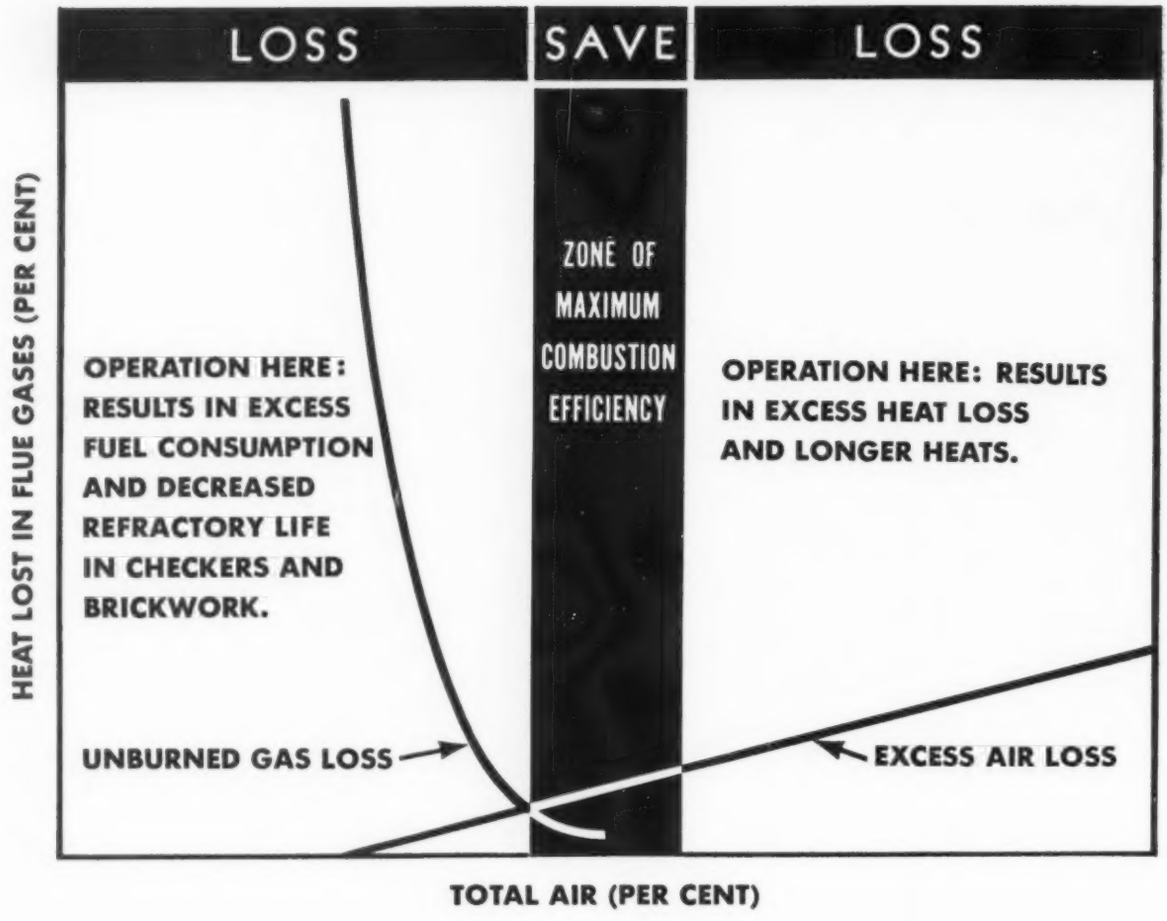
Today the Elliott C-W 620 Frame Mill motor extends the 600 series into the higher ratings required for bigger jobs. Rolled steel frame is horizontally split and all connections between top and bottom coils are brought out *external* to the motor. Windings are silicone insulated . . . entirely Class H . . . for longer life under extreme service conditions. Low inertia armature permits quick acceleration and deceleration. Tough and rugged, this motor remains especially easy to service and maintain.

More complete information on the 620 frame motor is included in Bulletin PB 9000-2. Bulletin PB 9000-1 covers 600 Frame motors in frames up to the 620.

ELLIOTT Company

CROCKER-WHEELER PLANT, JEANNETTE, PA.

To Save Fuel . . . Analyze for Combustibles, Too . . .


LOSS
SAVE
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ZONE OF MAXIMUM COMBUSTION EFFICIENCY
OPERATION HERE: RESULTS IN EXCESS FUEL CONSUMPTION AND DECREASED REFRACTORY LIFE IN CHECKERS AND BRICKWORK.
OPERATION HERE: RESULTS IN EXCESS HEAT LOSS AND LONGER HEATS.
UNBURNED GAS LOSS
EXCESS AIR LOSS
HEAT LOST IN FLUE GASES (PER CENT)
TOTAL AIR (PER CENT)

Standard Steel Works finds oxygen and combustibles analysis saves fuel; gives closer control of open hearths.

Results—Fuel conversion was completed without firing difficulties . . . and closer supervision of open hearth operation from a fuel-air ratio standpoint was realized. These were immediate results reported by Standard Steel Works Division of Baldwin-Lima-Hamilton Corporation, Burnham, Pa.

Oxygen and combustibles on same chart

The conversion from oil to oil-natural gas firing was tried first on one of five open hearths. Continuous analysis of combustion gases was added at the same time. The Bailey Analyzer-Recorder played a dual role in training operators, and giving engineers a fast check on the efficiency of the firing system.

Big Help—Part of the credit for success of the changeover goes to the gas analysis system. Here's why—

1. It measures the percentage of oxygen in the flue gas, which indicates the excess air loss.

2. It measures the percentage of combustibles in the flue gas, which is a check on the mixing efficiency of the burners.

3. It provides a continuous and permanent record of both variables on one chart, which, in addition serves as an operator's guide.

Money's Worth—The gas analysis system has been trouble free from the start (July 1957). Operators quickly mastered the technique of oil-gas firing with the help of the analyzer charts. Pleased with the results, Standard Steel Works is installing the same system on its four other open hearths.

Write for Performance Report OH11-1 for complete details on this installation. S12-1

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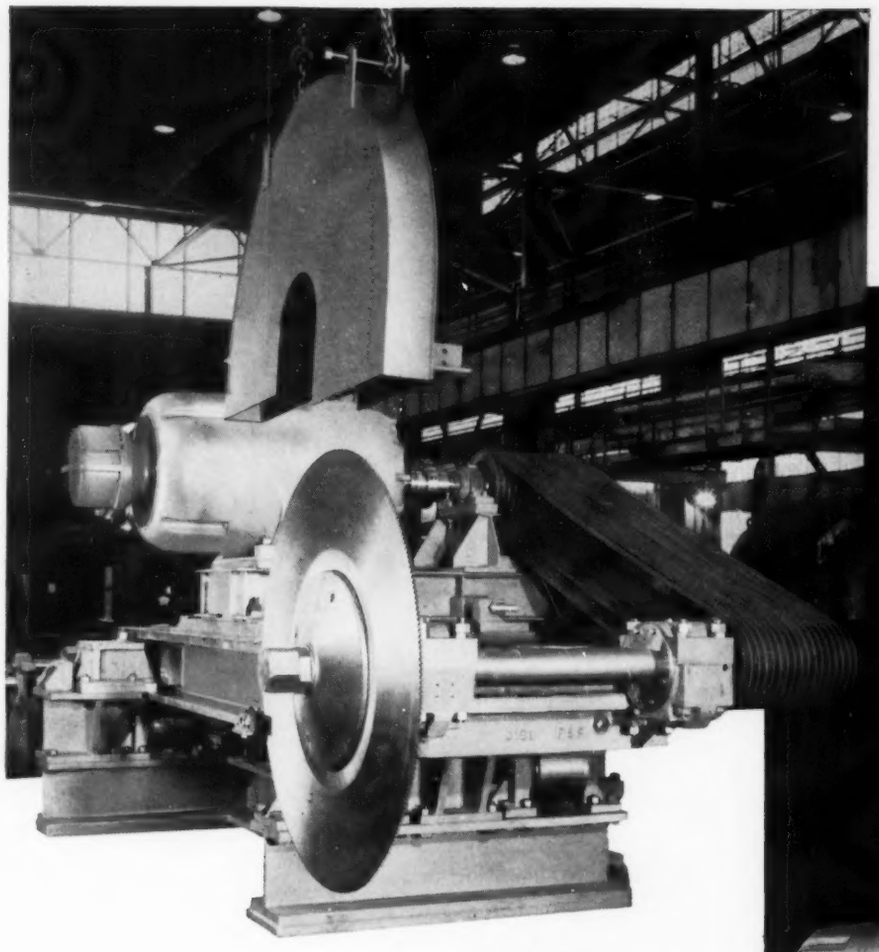
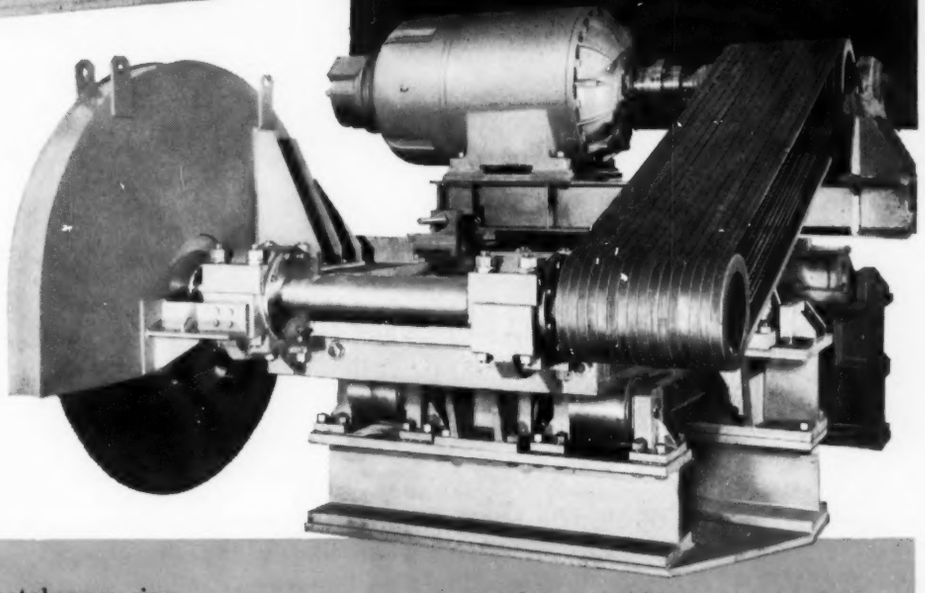


Auxiliary Equipment by Pittsburgh

HOT SAW



Hot Saw with 66" diameter blade

Ferrous and non-ferrous metal processing plants have numerous pieces of auxiliary equipment built by Pittsburgh Engineering Division. The Hot Saw illustrated typifies the manufacturing versatility of our shop. Specifications include: cuts up to 7" O. D. carbon steel solid rounds at approximately 1000° F.; direct belt drive; hydraulic feed control; and low maintenance costs. Consult Pittsburgh for your special requirements in auxiliary mill equipment.

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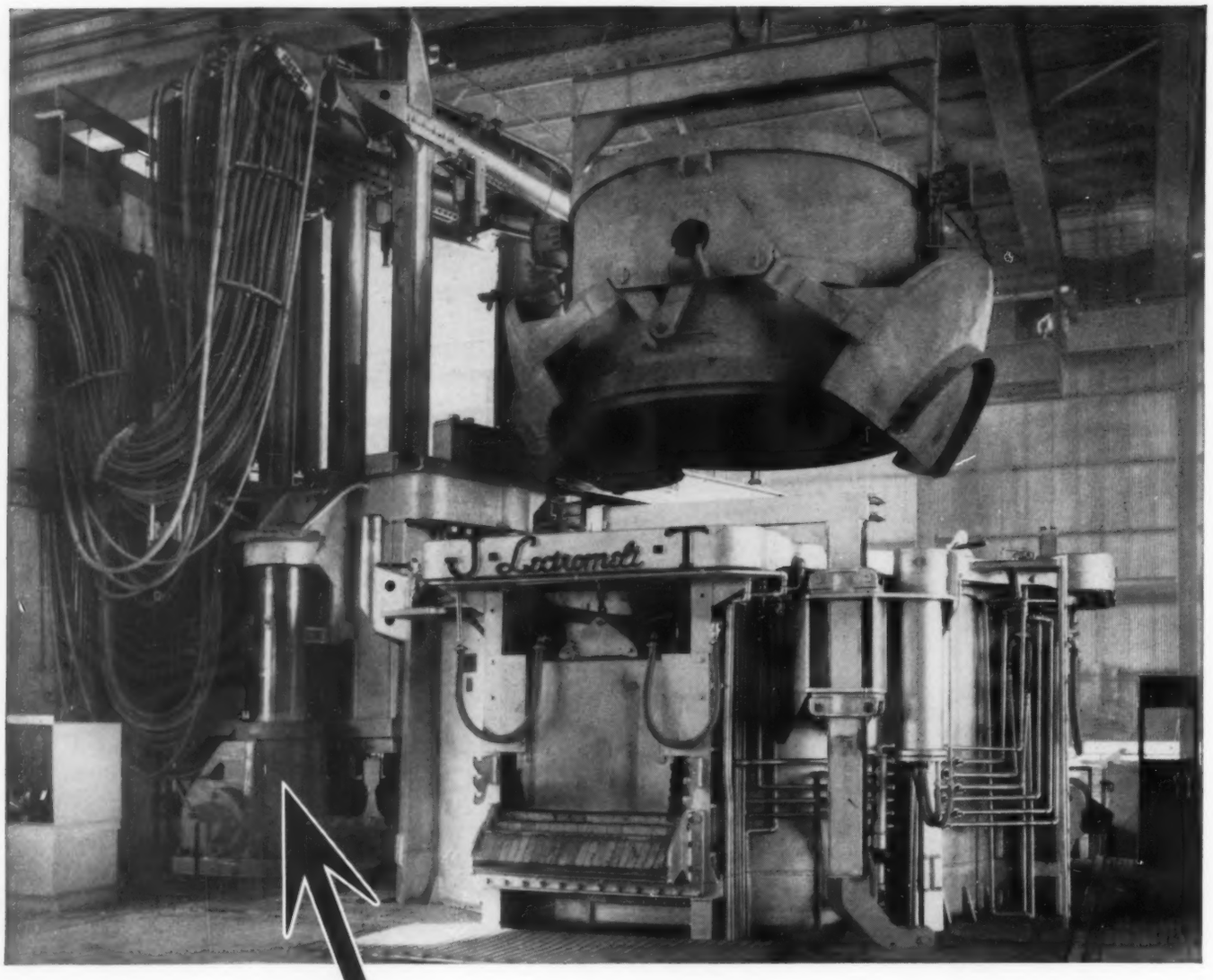

Separately mounted roof lift-and-swing mechanism on Lectromelt Furnaces . . .

Offers these advantages

★ **No heavy parts attached to furnace shell to cause strain and distortion**

★ **No jarring of roof, electrode arms or ram parts when heavy charges are dropped into the furnace**

★ **Allows uniform heat radiation all around the shell**

★ **Roof lift mechanism is away from excess furnace heat**

★ **Roof can be lifted higher, permitting larger charges**

★ **Shells can be readily interchanged**

★ ★ ★

All good reasons for specifying Lectromelt furnaces. They're described in Catalog No. 10. Lectromelt Furnace Division, McGraw-Edison Company, 310 32nd Street, Pittsburgh 30, Pennsylvania.

STANDARD SIZES UP TO TWO HUNDRED TONS CAPACITY

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Charging control on the No. 3 blast furnace at the Fairless Works represents the combined knowledge and efforts of operators, furnace builders and control engineers . . . . it meets the needs of blast furnace charging as the art is now known.

Automatic Charging Control for No. 3 Fairless Blast Furnace

by S. P. Curtis, Chief Engineer,* Fairless Works, United States Steel Corp., Fairless Hills, Pa.
R. F. Schramm, Assistant Chief Engineer, Arthur G. McKee & Co., Cleveland, Ohio
and D. W. Fath, Senior Electrical Engineer, Cutler-Hammer, Inc., Milwaukee, Wisc.

AT the present time there are two blast furnaces in operation at the Fairless works, U. S. Steel Corporation, Fairless Hills, Pa. A third furnace is complete and is ready for operation. This furnace is equipped with several new pieces of auxiliary equipment and we feel that the new charging control is one of the most outstanding of these new items. Specific objectives in the design of this new equipment were:

1. Providing a control with greater flexibility in choosing charging cycles, so as to realize the potential improvements in operating practices resulting from a greater variety of ores, sinter and fluxes.
2. Providing more information to operators and maintenance personnel and providing this information in a form which will be of maximum value to them.

The filling equipment for the new furnace consists of the following items:

1. A 300-cu ft, double compartment scale car for handling ore, scrap and stone to the skip car.
2. Three vibrating coke feeders on each side of the skip pit, which draw coke from the furnace coke bins.
3. A coke belt conveying furnace coke from the bins to the coke screen.
4. A double deck vibrating screen on each side of the skip pit, which discharges furnace coke into the weigh hoppers and under-size coke to the breeze conveyors.
5. Weigh hoppers and scales to measure the amount of coke.
6. Emergency coke bins and gates from which nut coke is fed directly into the weigh hoppers.
7. Water charging equipment, consisting of a volume meter and air operated rubber pinch valves.
8. Skip cars and double drum skip hoist.
9. Revolving distributor.
10. Small and large bells.
11. Equalizer and relief valves and valve operators.
12. Dual stockline measuring equipment.

HOIST HOUSE ARRANGEMENT

The electrical equipment in the hoist house, including the charging control, 480-volt switchgear, and 440-v motor control is located in a separate room with large windows. The hoist house ventilating system introduces cleaned air into the control enclosure and also into the main hoist room. Air is drawn from the room through the hoist motors on the hoist motor-generator set and exhausted to the outside of the building. In this manner a build-up of heat in the hoist house is prevented.

* At time of paper presentation. Now Chief Engineer—Steel and Coal, Central Operations, United States Steel Corp., Pittsburgh, Pa.

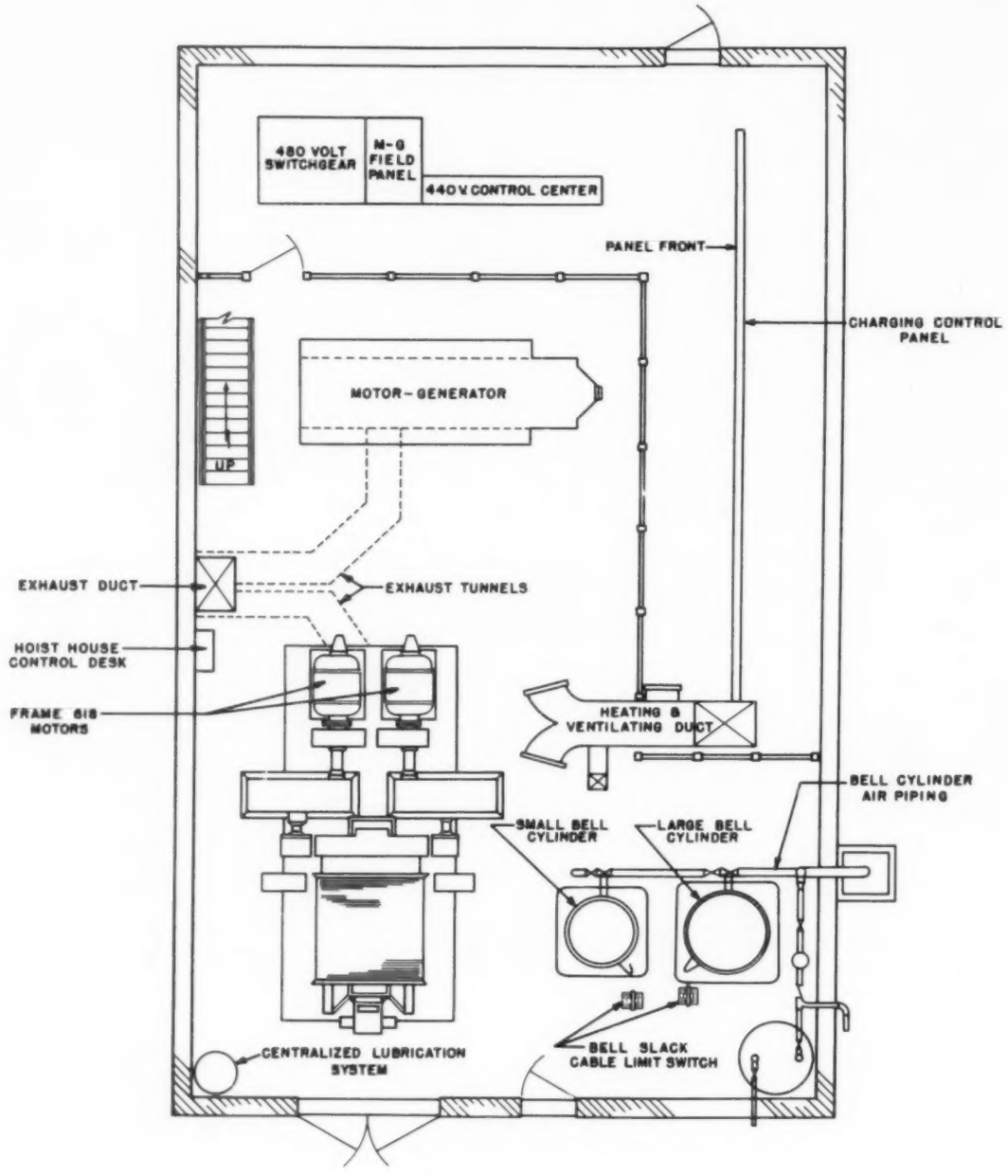


Figure 1 — First floor plan of No. 3 blast furnace hoist house.

The ventilation system is arranged to permit recirculation of a part of the air during winter months. Figure 1 shows the first floor plan of the hoist house.

SKIP HOIST OPERATION

The skip hoist is controlled by an adjustable voltage system with current limit acceleration and deceleration control. The power loop consists of a 350-kw, d-c generator feeding the two 200-hp skip hoist motors connected in parallel. The motor fields are shunt connected, and field excitation is controlled by contactors. The skip hoist is normally operated with both motors driving the hoist mechanism, and dropping resistors in series with each motor armature insure that the motors will share the load equally. Provisions have been made to operate with a single motor while making repairs on the other, and lower speeds are used with single motor operation to prevent overloading.

Generator armature voltage is regulated by a two-stage magnetic amplifier type regulator. Three different reference voltages are applied to the regulator during normal operation of the skip hoist, either under automatic operation by the charging control, or manually by the master switches. One reference voltage is set to produce a skip hoist speed of 75 fpm, which corresponds to 100 volts from the generator. This voltage is applied automatically when the skip hoist reaches the first slowdown point or when the master switch is set on the low speed point. A second reference voltage is set to produce a hoist speed of 150 fpm, which corresponds to 203 volts from the generator armature. This voltage is applied automatically when the loaded skip has left the pit, or manually when the master switch is set at an intermediate speed point. The third reference voltage is set to produce a skip speed of 475 fpm, which corresponds to 325 volts from the generator armature. This voltage is applied automatically when the skip is in the high-speed zone of travel, or manually when the master switch is set on the high-speed point.

The skip hoist is accelerated to approximately 240 fpm by adjusting the armature voltage and to 475 fpm by adjusting the field strength in two steps. Current

limit amplifiers regulate skip hoist generator armature current during accelerating and decelerating periods by balancing a reference voltage against a feed-back voltage which is proportional to generator armature current. The current is limited to approximately 2000 amp during the acceleration period with two motor operation. With single motor operation this current is limited to approximately 1000 amp.

Either skip hoist brake, but not both at the same time, may be removed from service for maintenance purposes. A dummy resistor is inserted in the brake circuit in place of the brake coil. The operation of each brake, one at a time, may be tested without actually running the skip hoist.

Provisions have been made to transfer the hoist motors to a spare generator located at no. 2 hoist house, in the event the main generator must be down for maintenance purposes.

DISTRIBUTOR OPERATION

The revolving distributor rotates loads to the 60-degree, 120-degree and 180-degree positions in the forward direction and then rotates in the reverse direction to the 300-degree and 240-degree positions. The distributor is driven through gear reductions by a 25 hp, 230-volt, d-c compound, mill type motor, 80 per cent shunt and 20 per cent series.

The distributor controller consists of a constant voltage, reversing, dynamic braking, d-c starter with timed acceleration. The controller is arranged for either automatic operation by the charging control or manual operation by the scale car operator. The distributor angle change is controlled by the selector switches on the charging program selection panel. The rotation angle will be changed 60 degrees at each point in the sequence where an angle change is set up.

SMALL AND LARGE BELL CONTROL

The small and large bell pneumatic hoist cylinders are controlled by three way air valves which are driven by ½ hp, d-c gear motors through suitable crank and linkage mechanisms. The valve mechanism is arranged so that 180 degrees of rotation of the crank arm on the gear motor moves the valve from the closed position to the open position, admitting air to the bell cylinder. The cylinder is raised by the compressed air, causing the bell to open. The next 180 degrees of rotation of the crank arm on the gear motor moves the valve from the open to the closed position, shutting off the compressed air to the bell cylinder and exhausting the cylinder to the atmosphere.

Four-contact rotary cam limit switches are driven by the valve operator motors and are used to stop the motors at the two valve positions and to energize indicating lights which show the positions of the valve operator mechanisms. Two track type limit switches are mounted so that one is tripped by a dog on each bell cylinder at each limit of travel. Contacts on these limit switches are used to interlock the small bell with the large bell, to energize indicating lights which show the position of the bells, and to signal the position of the bells to the charging controller. A third track type limit switch is mounted in such a manner that it detects any slack in the cable between the bell cylinder and the bell. The limit switch remains tripped when the cable is tight and resets when the cable is slack. The limit switch is used to reverse the direction of travel of the bell cylinder to remove the slack that has been detected and to sound an alarm to indicate that the bell is inoperative due to some failure which caused slack cable.

When the charging control is set for automatic operation, the bells are automatically opened and closed at the proper times under control of program switches. When the control is set for manual operation, the bells may be operated by master switches on the manual operation section of the stockhouse panel. Pushbutton stations are located near the bell cylinders for manually operating both the small and large bells when the charging control is set up for manual operation. These stations make it convenient for one man to test the operation of the valve operators and bell cylinders while standing near the equipment. Indicating lights are provided on the push-button station which show the positions of the small bell, the large bell, the equalizer valve, the relief valve and the stockrods.

Interlocking is provided to insure the following sequences, regardless of whether the furnace is under automatic or manual control:

1. Before the large bell can be opened, the small bell must be closed, the top pressurized and the stockrods withdrawn.
2. Before the small bell can be opened, the large bell must be closed and the relief valve must be open.

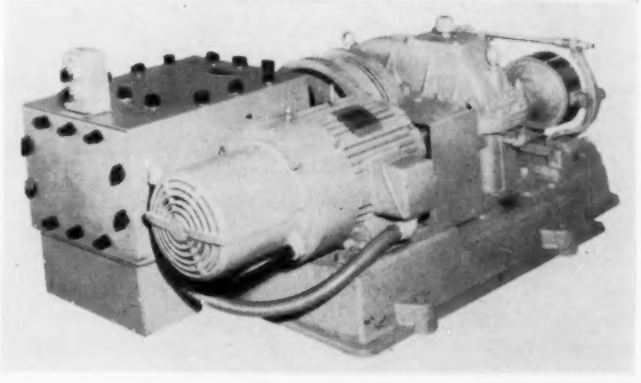
This interlocking can be by-passed if necessary, but only by a key-operated selector switch on the hoist house control panel.

EQUALIZER AND RELIEF VALVES

The air cylinders for operating the equalizer and relief valves are controlled by gear motor operated air valves identical to those described for the operation of the large and small bells. There is a four-element cam-operated limit switch on each valve operator for stopping the valve operator motor at the two positions and for operating indicating lights.

A push-button station is mounted on the relief valve operator for testing the operation of the relief valve and equalizer valve. This pushbutton makes it convenient for one man to test the valve operators while standing in a position where they can be observed. This station may be used at any time, even while the charging control is on automatic operation, since a selector switch is

Figure 2 — Two stockrod hoist units are provided.



provided which transfers operation from the charging control to the push-button station. When this selector switch is turned to the "off" position, the relief and equalizer valve operators are locked out and cannot run. This is a convenient safety feature for preventing unexpected operation while making adjustments to the mechanism.

Lights indicating the positions of these two valves are mounted on the pushbutton station. Six neon indicating lights mounted on the hoist house annunciator panel show the positions of the relief and equalizer valves and the pressure condition at the furnace top.

STOCKROD HOISTS AND RECORDERS

Two complete stockrod hoist and recorder systems are provided with the charging control. The hoist mechanism consists of a cable drum driven by an a-c squirrel cage torque motor through a suitable gear reduction, a d-c mill type shunt brake, a selsyn transmitter for driving the stockrod movement indicator, a rotary cam limit switch for final travel limits, a rotary switch for energizing the stockline position lights, and a dual transmitting rheostat for driving the stockline indicator-recorders on the stockhouse panel and the pyrometer house panel. See Figure 2.

The stockrod movement indicator consists of a selsyn driven pointer and a back lighted dial which is calibrated to indicate one inch of travel of the stockrod for each revolution of the pointer. The selsyn drive is disconnected electrically by a timing relay during the hoisting and lowering periods associated with the dumping of the large bell, because the rapid movement of the stockrod hoists would otherwise spin the stockrod movement indicator at excessive speed.

The stockrod recorder-indicator is provided with a 24-hr chart calibrated from 0 to 20 ft, and a pointer with a dial plate calibrated from 0 to 20 ft. A chart storage compartment is provided below the recorders on the stockhouse indicator panel for storing the ink and charts for the recorders.

When the burden reaches a specified distance from the furnace top, a contact in the stockrod recorder automatically prevents further charging of the furnace by locking out the large bell dumping operation. Control switches for raising and lowering each stockrod are variously located on the scale car operator's desk, the hoist house control station, the mud gun operator's desk, and the manual operation section of the stockhouse panel. The stockrods can be hoisted from any of these points regardless of the mode of operation of the charging control. A pushbutton station is mounted on the stockrod hoist mechanism for testing the operation of the hoist. The usual ten-light stockline position indicators are mounted in the cast house and the stockhouse; these lights are energized through the rotary switch geared to the hoist drum.

An indicating light for each stockrod is mounted on the pushbutton station located at the relief valve operator mechanism. These lights are energized only when the stockrods are in the retracted position. A rectangular indicating light for each stockrod is located above the "stockrod in-out" selector switches on the scale car operator's desk. These lights, too, are energized only whenever the stockrod hoist motor is energized. When these lights are de-energized, it indicates that the stockrods are either in the retracted position with the stockrod control locked out at the local push-button station, or the extreme lower limit switch has stopped the stockrod at the 20-ft level.

COKE SYSTEM

The coke system controller provides for filling and discharging the two coke weigh hoppers either automatically or manually with either furnace coke or nut coke. When the system is set up for automatic operation, the amount of coke placed in the weigh hoppers may be controlled either by weight or by volume. The controller provides for alternating the bins from which coke is drawn in combinations of two bins or one bin at a time. Drawing coke from two bins simultaneously reduces the time required to load the weigh hopper.

When the coke bin selector switch on the hoist house selector panel is set in the "two bin" position, coke is fed consecutively in combinations of bins 1 and 2, bins 2 and 3, and bins 1 and 3. The bin or bins from which furnace coke is being drawn may be changed manually by pressing the "change bin" pushbutton located on the hoist house selector panel. Each time this button is pressed, the coke bin program is indexed one position, and a different bin or combination of bins is selected.

The determination of whether coke is to be charged automatically or manually is made by selector switches on the transfer section of the stockhouse panel. The two coke system on-off selector switches on the scale car operator's desk in the stockhouse must be set in the "on" position if automatic charging has been selected. When coke is being charged automatically into the skip car, the control proceeds with this action provided the charging program is calling for a coke charge, provided the weigh hopper being used is full by weight or volume, and provided the correct skip car is in the pit and ready for filling. If the above conditions are satisfied, the weigh hopper gate solenoid is energized, air is applied to the discharge gate cylinder, and the gate opens, dumping coke into the skip car.

When all of the coke has been discharged, the scale zero weight contact closes, energizing a timing circuit. After a short time delay which allows the last of the coke to dribble from the weigh hopper, the discharge gate solenoid is de-energized, connecting air to the return end of the gate cylinder, and the gate closes. After the gate has closed, the charging control is signaled that the skip car is filled with coke, and the skip car is started automatically.

After a weigh hopper has been emptied, and the gate closed, the zero weight contact operates to start the coke screen. A timing relay in the coke screen starter allows a short time for the coke screen to accelerate, after which the coke belt is started. A timing relay in the coke belt starter allows a short time for the coke belt to accelerate before the power is applied to the coke bin vibrating feeders selected by the coke bin program device.

The coke system control has been made flexible in order to keep as much of the equipment on automatic control as possible when there is trouble in some part of the system. The weigh hopper filling control may be placed on manual operation while the weigh hopper discharging control is left on full automatic operation, or vice-versa.

If one side of the coke system becomes inoperative because of some electrical or mechanical defect, that side of the system can be removed from the charging sequence merely by manipulating the proper control switches provided for this purpose. In such event, the skip car on the inoperative side of the system will automatically be sent up empty if a coke charge is due, and the missing charge will be supplied by the other side of the system without any disruption of the automatic counting of the charging control.

When coke is to be charged by weight, it is fed into the weigh hopper until the full-weight contact on the scale closes, indicating a full charge of coke has been placed in the hopper. Through the necessary relaying the filling equipment is then stopped.

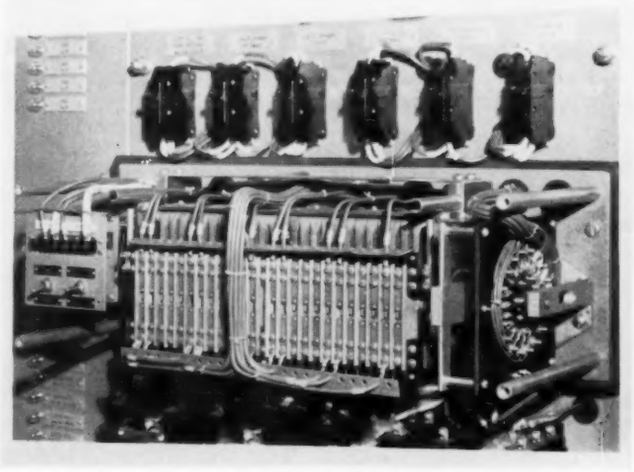
When furnace coke is to be charged by volume, it is dumped into the weigh hopper until it bridges between the two coke electrodes.

The full volume relay always backs up the full weight relay when filling by weight; therefore, if the scale contact or the full weight relay fails to function, the full volume relay will turn off the coke filling machinery and prevent an overflow from the weigh hopper.

In case of emergency, both weigh hoppers can be filled automatically with nut coke. Since nut coke is not screened, it is drawn directly from the nut coke bin into the weigh hopper, and the coke screen, coke belt and coke vibrating feeders are all inoperative. If the bin discharge opening becomes jammed with coke, and the flow is halted, the scale car operator can jog the bin gate. This action should jar the jam-up of coke enough to break it loose. When the scale full weight contact closes, or when the coke electrodes are bridged by coke, the control operates to de-energize the nut coke fill gate solenoid. Air is applied to the closing end of the gate cylinder, and the gate closes. The weigh hopper is thus filled with nut coke and ready for discharge into the skip car.

The weigh hopper gate solenoids and nut coke gate solenoids are located in the bottom compartment of the stockhouse indicator panel. The solenoids are readily accessible for manual operation. The function of each solenoid is clearly marked on name plates attached to the solenoid mounting brackets. Each solenoid includes a small mechanical push rod type over-ride for manually operating the valve. By operating the over-ride buttons, nut coke may be dumped into the weigh hopper and discharged from the weigh hopper into skip cars in case of nonfunctioning of the solenoids.

Figure 3 — The five program switches are of the cam type.



At this point it may be of interest to note that on this furnace all of the air used for the operation of gates, valves, etc., is dried instrument air, thus reducing the possibility of trouble due to frozen air lines.

Six rectangular indicating lights for each coke system on the scale car indicator panel, and repeated on the hoist house indicator panel, indicate the condition of key parts of the coke system. A group of three of these lights indicate the amount of coke in the weigh hopper. The lights are marked "zero weight," "full weight," and "full volume." There is also a light marked "discharge open" that is lighted when the weigh hopper discharge gate is open. Two lights, colored red, are lighted only when the breeze conveyor and coke screen hood fan are not running.

PROGRAM SWITCHES

The program switches are the rotating cam type, fabricated of separate removable units mounted on a common base (Figure 3). The cam shaft unit has 24 separate machined aluminum cams on a square shaft which is mounted on ball bearings. The contact block is readily removed, and it is hinged for inspection of contacts without disconnecting the attached wires. The contacts are double-break, sintered silver, non-sticking, self-wiping units. A rotary brush selector switch unit is coupled to the cam shaft to show program switch position by a group of lights mounted on the fault finding panel in the hoist house.

The switch drive unit consists of a 110-volt, single-phase, shaded pole motor with an integral brake for accurate stopping. Test and reset switches are provided for maintenance purposes.

THE WATER CHARGING SYSTEM

Water may be dumped into any skip load automatically, and in any quantity up to 180 gal. The water volume is adjustable in 20-gal increments by a ten-position selector switch located on the scale car operator's desk. Water is programmed on the hoist house selector panel, as will be explained later.

Water is obtained directly from the water mains and is dumped into the skip car without being stored in a tank. The volume of water passing through the 4-in. feeder is measured by a volume type water meter. The water meter is equipped with a micro-switch which is tripped momentarily after each 20-gal increment of water has passed the meter. There is also a dial with pointer on the meter that makes one revolution for each 20 gal of water. The volume of water passing through the meter is measured by counting the number of electrical impulses received from the micro-switch inside of the meter.

On the output side of the water meter, there are two 3-in. branches, one to each skip. An air-operated rubber pinch valve controls the flow of water in each branch. The air-operated valves are held closed as well as opened by air. The solenoid valves which apply air to the air operated water valves, pressure regulators and indicators are mounted in the bottom of the stockhouse indicator panel. The solenoid valves have provision for manual operation, as mentioned previously.

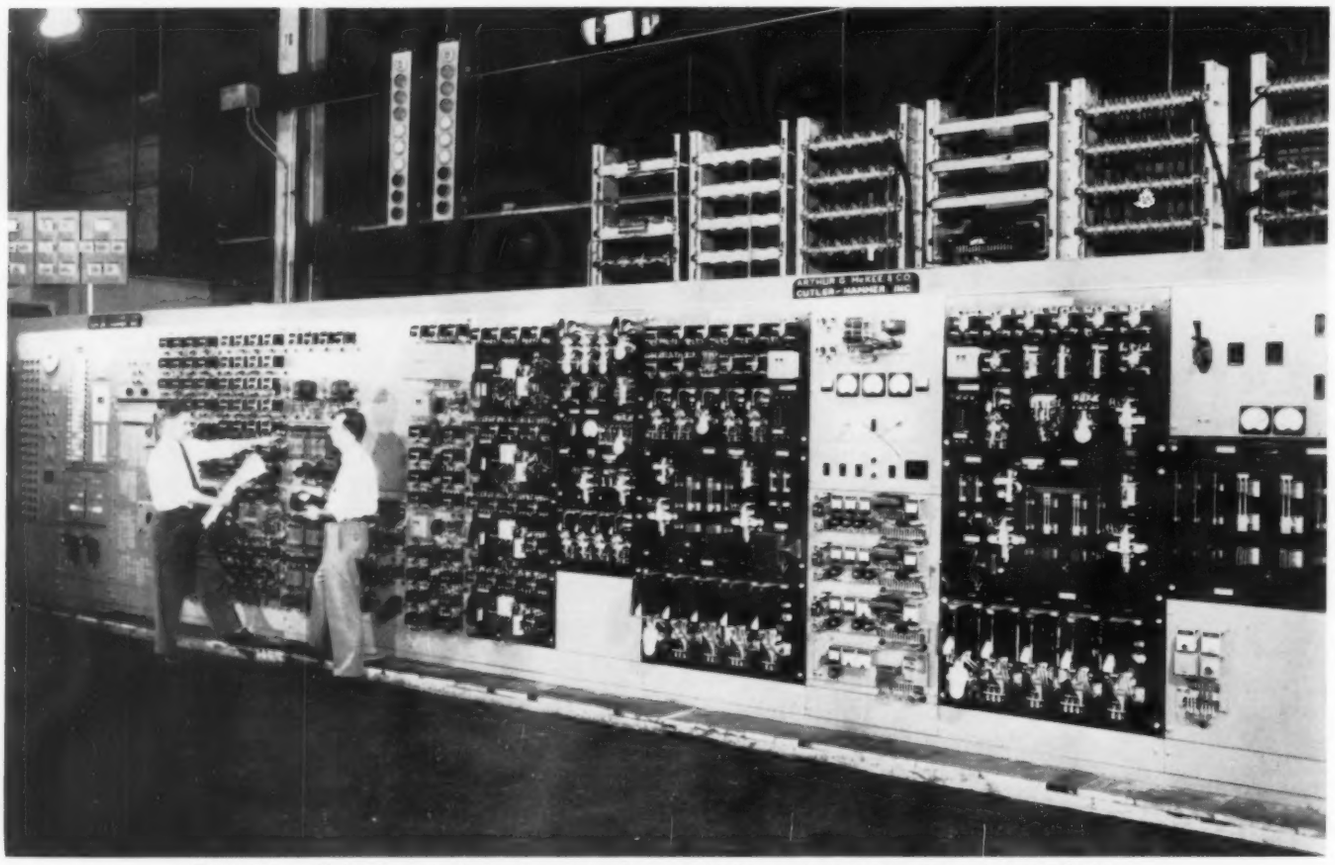


Figure 4 — Hoist house charging control panel is shown in factory prior to installation.

EQUIPMENT IN THE HOIST HOUSE

The complete system of charging control includes equipment located in both the hoist house and the stockhouse. The major item in the hoist house is a panel 35-ft long on which are mounted all of the control devices (relays, meters, voltage regulators, etc.), the power transfer switches required for transferring from the main motor-generator to the spare motor-generator, the equipment for setting the charging cycle, and the indicating and annunciating facilities (Figure 4). The charging cycle selection and indication functions are among the most notable features of the system, and they will be examined at this point.

The section on the extreme left of the panel contains the equipment used in setting the charging cycle (Figure 5). There are eighteen horizontal rows of selector switches, with four switches per row. Each row corresponds to one skip load, so there can be a charging cycle of as many as eighteen skips. For each skip, and therefore for each row of selector switches, the following four selections are made:

1. Whether or not to dump the large bell.
2. Type of burden (coke, stone or ore).
3. Whether or not to add water.
4. Whether or not to change the distributor rotation angle.

As the burden selections are made, they are automatically registered on an illuminated burden card on the adjacent section of the panel. The windows of the burden card are engraved with the name of the material, and they are also colored to reflect the type of load: blue for coke, yellow for stone, and brown for ore.

The column of lights to the left of the burden card indicates the selected points in the cycle where the large bell will be dumped. Lights in a vertical row to the right of the burden card serve as a pointer for the operator by indicating the next load to be charged. At the beginning of the cycle, the top light, or no. 1 light, will be illuminated. As soon as the first load has been dispatched, this light will go out and the second light will be energized. This progression continues as the charging program proceeds, so that the next load to be charged is always readily apparent.

The load cycle counter above the charging sequence panel of lights is a digital indicating light showing the current cycle.

In addition to the program selection switches, selector switches are also provided for various other functions. One selector switch is provided to permit transfer of the skip hoist motors to full field operation for heavy loads. A group of selector switches is also provided for the coke system. Two of them are to select weight or volume measurement of coke in the left system and the right system, and the third one is provided to permit drawing coke from one bin at a time or two bins at a time in alternate combinations. A pushbutton is also provided to manually change bins at any time. Key-operated selector switches are provided for the bell interlock and scale car interlock so that these interlocks may be by-passed. Disconnect switches are provided on this panel for the skip hoist control power and the scale car d-c power.

The section below the burden card is devoted to coke system indication. There are six rectangular indicating lights for each of the two coke systems which indicate the condition of key parts of each coke system. The two

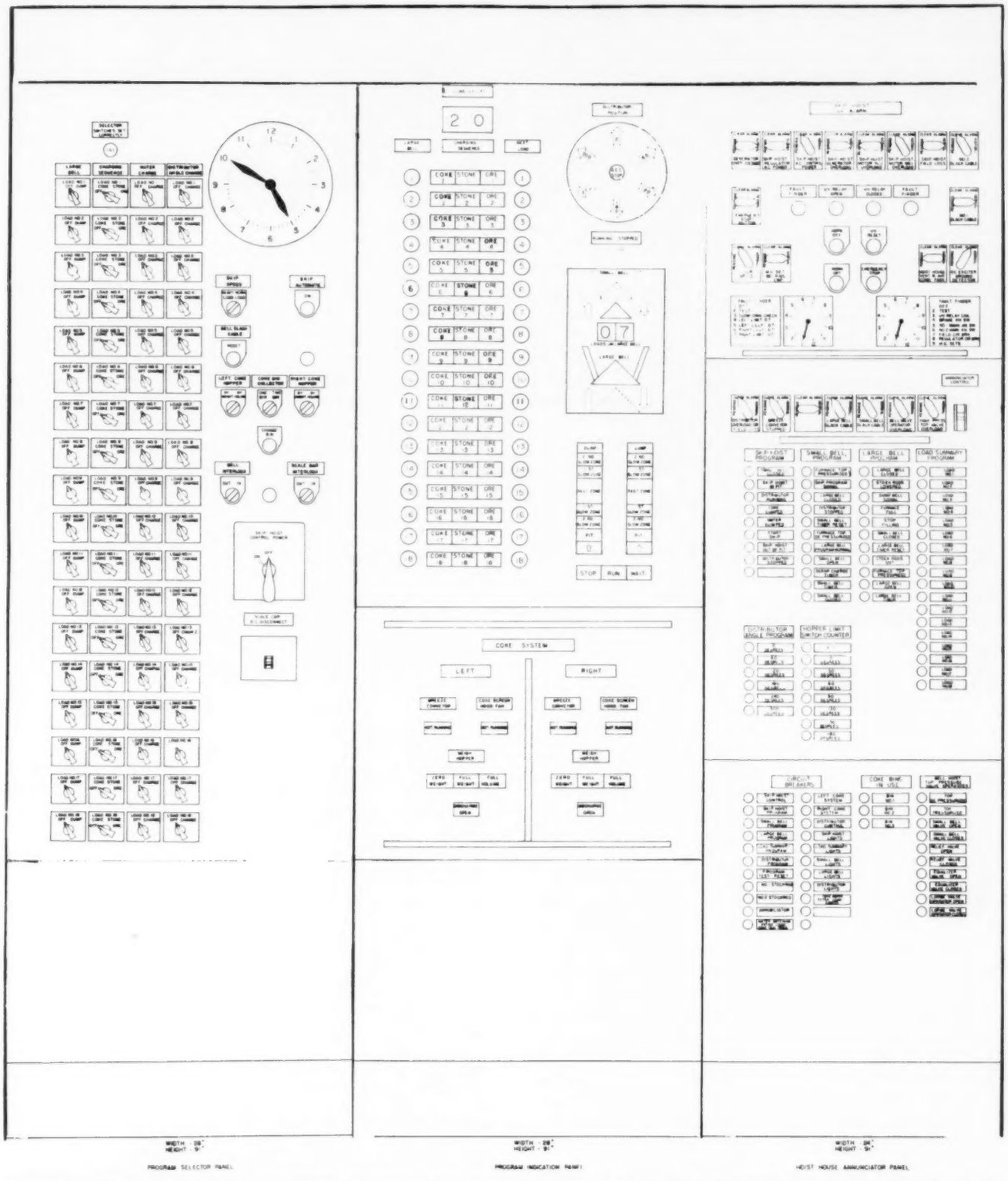


Figure 5 — Part of the hoist house charging control panel includes: left, charging cycle selection panel; center, charging cycle indications; and right, annunciators, fault finders and program switch supervision.

red lights at the top, identified as "breeze conveyor" and "coke screen hood fan," are illuminated only when these units are not running. The fact that these lights are ordinarily not energized keeps the number of lights visible on the panel at a minimum and therefore makes the indication panel easier to read. Three lights are grouped together to indicate the amount of coke in the weigh hopper. These lights are marked "zero weight," "full weight," and "full volume." At least one of these lights should be on at all times. The single rectangular light at the bottom indicates when the weigh hopper discharge gate is open.

The actual operation of the charging equipment is depicted by the next group of indicating lights. Two vertical rows of rectangular lights near the bottom represent the two skip cars. With one skip car in the pit

and the other in the dumping position, the bottom light marked "pit" in one row will be energized and the top light marked "dump" in the adjacent row will also be energized. An arrow pointing upward will also be energized in the rectangle just below the light marked "pit." When the skip hoist operates, the lights will move progressively upward in the one column and downward in the other to represent the movement of the two skip cars. Should the operation be interrupted at any time, the lights clearly indicate the positions of the skip cars, and the arrow at the bottom indicates which car was on its way to the top. There are three lights grouped across the bottom marked "stop," "run," and "wait," and at least one of these lights must be on at all times. The "stop" indicating light is energized whenever the skip hoist is stopped in normal operation. The "run" indicating light is energized when the skip hoist is running, and the "wait" indicating light is energized when the skip hoist has stopped and is waiting for some other step in the program to be completed before proceeding to the top to dump the load onto the small bell.

The operation of the large and small bells is graphically shown on an indicating panel. The two side bars remain lighted at all times. The triangles representing the small and large bells indicate whether the bells are open or closed. Arrows adjacent to the triangles are energized to show whether the bells are in the process of opening or closing. A digital lamp in the center of this panel indicates the number of loads on the large bell, whether they are a part of the pre-selected charging program, or extra loads that have been added by the operator. The numbers reset to zero whenever the large bell is dumped.

The distributor is represented by a dial with six arrows at 60-degree intervals corresponding to the six distributor positions. An "accurate stop" indicating light is located in the center of the circle, and this light is energized whenever the distributor is accurately stopped. Two rectangular lights, associated with distributor position indication, indicate whether the distributor motor is stopped or running.

The description of the panel has thus far included a great deal of indication, but it should be noted that this indication has been arranged in a manner that makes it easy to focus attention on any particular item desired. This has been accomplished by the use of different shapes of lights, different colored lenses, grouping of indication according to function, and graphic or action type of indication. It should also be noted that a very definite plan of color coding of the indicating lights has been followed.

Red is used only to indicate an emergency condition, and consequently during normal operation no red light should appear.

Green lights are used to indicate that a device or a machine is energized and is running at the time the light is on.

An amber light indicates that a device or machine has stopped due to the normal sequence of operation.

A yellow light indicates that a device or machine has stopped temporarily waiting for some other operation to be completed.

White is used on all graphic indicators to show the position of a device. Thus complete information is readily conveyed to the scale car operator or to maintenance personnel with a minimum delay and minimum possibility of error or misunderstanding.

With the importance of keeping charging downtime to a minimum, an annunciator panel has been included in the hoist house as an aid in quickly locating troubles and determining the point in the cycle at which operation was interrupted. The fault finders and indicating lights to accomplish this have been grouped on one panel so that all of this information is available at one central location. A quick inspection of the annunciator panel will pin-point the device which operated. In addition to these fault finding devices, this panel includes neon type indicating lights which show the position of all of the control circuit breakers, the position of the bell and high pressure top valve operators, the condition of the coke system and water system devices, and the position of the charging control program switches. Each indicating light is marked with a description of the device or operation that it monitors. The neon lights monitoring the charging control program switches clearly depict the program progression, and show at a glance the position of each program switch at any particular instance. Thus, if operation is interrupted due to any malfunctioning of equipment, the maintenance electrician will be able to go directly to that section of the panel controlling the operation that was interrupted. This eliminates the necessity of checking numerous circuits in order to isolate a fault.

The automatic charging controller includes five motor driven program switches, one latched relay type counting device and three motor driven type counting devices. These devices provide a forced interlocking scheme which initiates all operations and checks to see that each operation has progressed satisfactorily before initiating the succeeding operation. The five motor-operated program switches serve to control the skip hoist program, small bell program, large bell program, load summary program and distributor angle program.

The motor driven counting devices each consist of two 24-position rotary switches which are rotated one step at a time by a driving motor. They are used to count the loads on the large bell, the number of complete load cycles and control the coke bin program. The balance of the charging control consists largely of conventional relays and contactors.

A control desk in the hoist house (Figure 6) includes all devices generally used by maintenance personnel for setup and test operations. Included on this desk are a

Figure 6 — Skip hoist auxiliary control desk in hoist house includes all devices normally used.

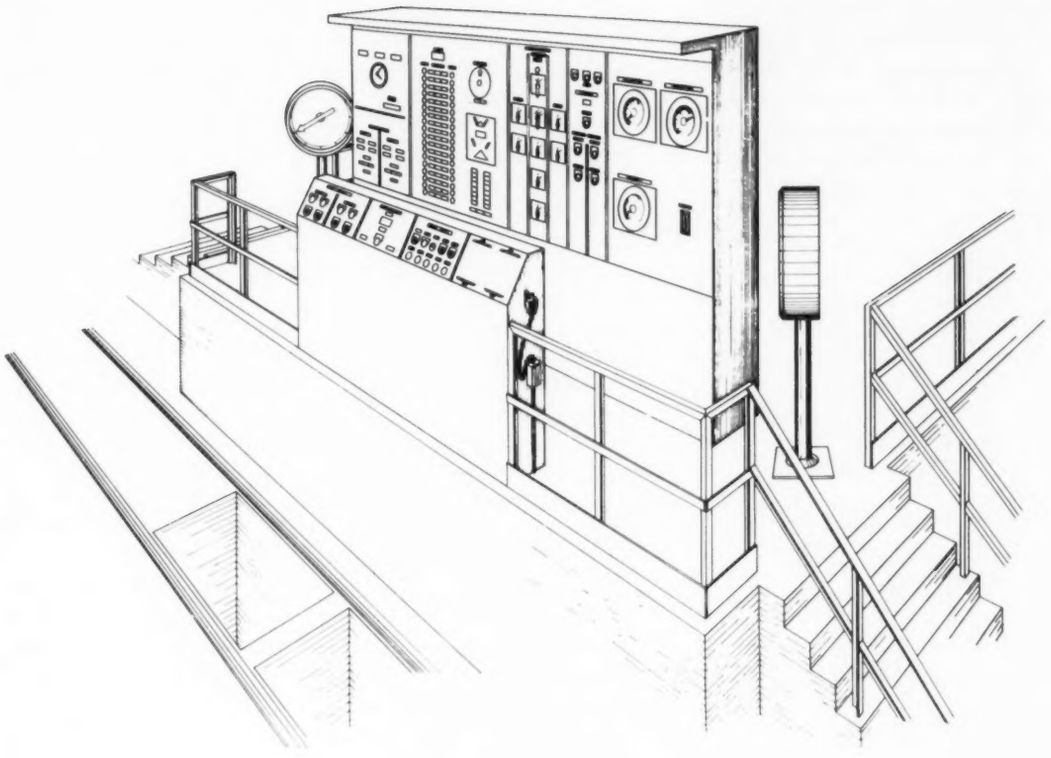


Figure 7 — Architect's drawing shows charging control equipment in stockhouse.

skip hoist control master switch, slack cable back-out pushbutton, skip hoist motor brake test pushbuttons, stockrod control switches, and an emergency stop button.

EQUIPMENT IN THE STOCKHOUSE

The charging control in the stockhouse consists of two major pieces of equipment; The scale car operator's desk, and the combination indicating-manual operation panel (Figure 7).

The scale car operator's desk is a compact unit which contains all the control devices required for normal charging of the furnace from the scale car. The top of the desk is divided into four sections by stainless steel divider strips, and each section is identified with a large name plate designating the function of that section.

The left end section is for the coke system. The operator need only choose nut or furnace coke and turn the coke system on. If the coke hopper does not close, he can jog it closed. A zero weight by-pass button allows the operator to close the hopper gate even though zero weight is not obtained.

The next section, the automatic cycle section of the desk, includes five rectangular indicating lights and one pushbutton, which is for starting the skip hoist. The charging of coke is completely automatic, including starting of the skips, but each load of ore and stone delivered by the scale car must be started up by operation of the "start skip" pushbutton. The indicating lights adjacent to the pushbutton serve to advise the operator which skip car is in the pit and ready to be filled. The light directly above the pushbutton indicates to the operator when a skip car is ready to be started. The large rectangular indicating light shows that the next load is to consist of an automatic coke charge, and the smaller rectangular indicating light at the top of this section serves to indicate that water is to be charged on the next load.

The third section of the scale car operator's desk is devoted to devices employed in modifying the charging program. A selector switch is provided in this section to permit the operator to stop the skip hoist at any time that he may find it necessary to interrupt the charging operation. The indicating light above this selector switch is illuminated when the skip hoist is on automatic operation. In the event that it becomes desirable to reset the charging program at any point in the cycle, this may be done when either skip is in the pit by operation of the "program reset" pushbutton. During the reset operation, the large bell is automatically dumped and all program switches and counters are reset to their initial positions to return the entire system to its starting point. The rectangular indicating light marked "reset ready" tells the operator when the reset operation is complete. This light is energized momentarily at the completion of the reset operation. All lights indicating the charging sequence are off during the reset period and are turned on at the completion of the reset cycle. Other devices in this section are the water volume selector switch, which has been mentioned previously, and two rectangular indicating lights pertaining to the water charging system. One yellow light marked "water charge" is on only when an automatic water charge is scheduled for the empty skip car entering the pit. The particular skip loads for which this light is energized depends on the water charge program set up on the hoist house selector panel. The second light is on only when water is actually flowing into the skip car. Two selector switches are also provided on this section of the desk to permit the operator to raise and lower the stock rods independently at any time during the charging operation, except when the large bell is being dumped on automatic operation.

The bottom row of pushbuttons and indicating lights on the charging section of the scale car operator's desk permits the introduction of extra loads without upsetting the normal charging program. One pushbutton is provided for extra scrap, one for extra ore or stone, one for extra coke, and one for extra water. Operation of any one of these four pushbuttons before an empty skip car reaches the pit will prevent the automatic dumping of water or coke into a skip car should either of these be called for by the selected program. Extra scrap, ore or stone must then be deposited in the skip car by the scale car operator. Extra coke or extra water will be dumped into the scale car automatically, if either of those buttons have been operated. The indicating lights above these pushbuttons serve to indicate when an extra load pushbutton has been operated, and the light corresponding to the extra load selected will remain on until the load has been dispatched to the top of the furnace. If the extra load is called for, it may be cancelled by the operation of the pushbutton provided for that purpose. The "cancel extra load" indicating light is energized at all times except when an extra load pushbutton has been operated. Operation of the extra scrap pushbutton causes one additional change in the operation of the charging equipment, namely, the control for the small bell program will hold the small bell open while the scrap is being dumped on the large bell from the skip car. In the case of all other extra loads, the small bell will function in its normal manner.

The remainder of the scale car operator's desk consists of a blank section equipped with clips for holding instruction sheets or record sheets for the convenience of the operator. The top of this section is hinged to provide a storage compartment for record sheets, pencils and other miscellaneous materials. The three sections mounting the operative devices and indicating lights are completely dust-tight, and the opening of the storage compartment does not expose the connections to the operating devices. All of the pushbuttons on the scale car operator's panel are covered with protective boots made of special silicone composition to completely exclude the entrance of dust around the pushbuttons.

On the left end of the scale car operator's desk is a skip hoist control circuit disconnect switch provided for the convenience and safety of maintenance personnel. This switch may be operated either from the scale car or from the stockhouse platform, and may be locked in the "off" position with up to three padlocks.

To the rear of the operator's desk is the indicating-manual operation panel, which is also sectionalized to set apart groups of devices according to the functions they perform. The operator can clearly see this panel when standing on the scale car. The panel is also readily accessible to maintenance and operating personnel from the platform between it and the scale car operator's desk.

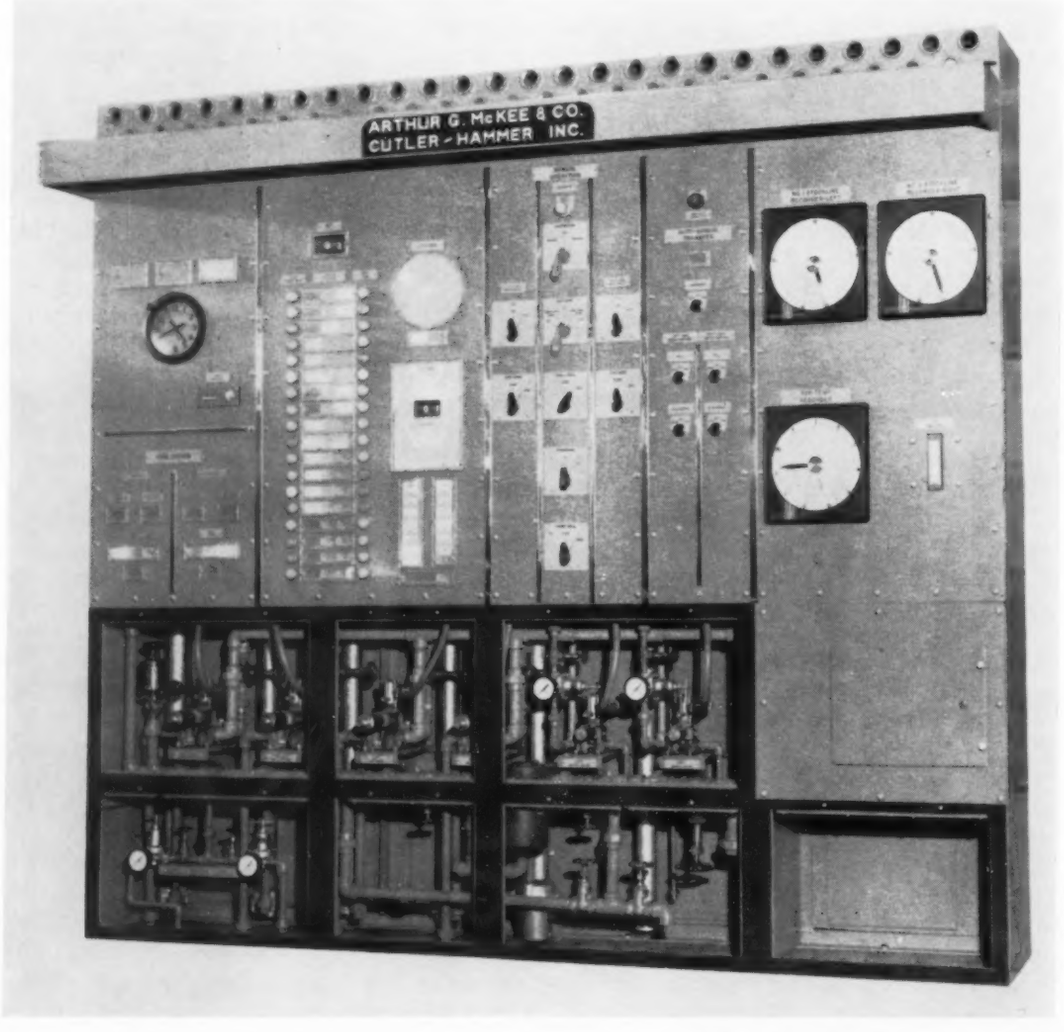


Figure 8 — Indicating —manual operation panel in stockhouse has covers removed from lower section to show water and air valves.

The upper left hand section includes three alarm indicating lights with large, rectangular, red lenses: the "stop filling" light is energized by means of a switch on the mud gun operator's panel, the "high top temperature" light is energized when the top temperature exceeds a preset value, and the "control alarm" light is energized at any time that the under voltage relay is de-energized. These indications are of an emergency nature, and because of their size and color, and the fact that they are set apart from other indication, it is immediately apparent to the operator when they light. Also in this section is a total load counter which keeps a running total of the skip trips to the top of the furnace.

The next section is a duplicate of the indicating panel in the hoist house. Thus the scale car operator has within his purview the burden selection; distributor, bell and skip hoist operation; and the operation of the coke system.

On the next section of the panel, provision is made to permit charging of the furnace manually should this become necessary or desirable at any time. A group of transfer switches is provided to transfer the circuits from automatic operation to manual operation, and adjacent to these are master switches which are to be used for the actual manual operation of the equipment. Selector switches are provided to permit placing a part or all of the coke system on manual control, and also to permit automatic coke charging while the rest of the charging operation is performed manually. All essential interlocks maintain their supervision during manual operation. For example, the large bell cannot be dumped without first withdrawing the stock rods from the furnace. All indication is in effect during manual operation.

The right hand section of the panel is devoted to combination indicating-recording meters for the stock line and top temperature, as well as a top pressure indicator. Solenoid valves for the coke system and water charging are mounted in the lower portion of the stockhouse indicator—manual—and transfer panel (Figure 8). These solenoid valves are accessible by removal of plates from the front of this cabinet, and each one may be operated manually in the event of total electrical failure. The section in which the solenoid valves are located is completely isolated from the electrical sections of this panel, and the electrical compartment is completely dust-tight.

PRINCIPAL FEATURES

Following is a summary of the outstanding features of this charging control:

1. The control is virtually all 110-volt a-c. The control power is transformed from 440 volts to 110 volts by the use of five separate transformers, furnishing power for the following:
   - Indicating lights
   - Program switches
   - Skip hoist control
   - Skip hoist voltage regulators
   - Miscellaneous uses

   The secondaries of these transformers are divided into a total of 26 individual circuits, each protected by a circuit breaker. The isolation provided by this circuitry allows for easy maintenance.

2. The 440-volt motor control for drives associated with the charging control are standard combination starters in control centers, which allows the easy replacement of units and protects operating personnel from accidental contact with the higher voltage. There are no 440-volt circuits on the charging control panel.

3. Program switches provide a separate cam and contact for each function or action and a corresponding light indicating when that has been accomplished. Light indication is isolated from control function by providing separate contacts for each. This is in contrast to systems which direct as many as eight to ten functions through one cam and contact and which mix the light indication with the control.

4. A very complete indication and fault finding system which accurately pin-points the last operation performed and provides maximum fault finding facilities. The indication has been expanded to show individual, rather than a group of, events. The protective device contacts, along with limit switch contacts, overspeed switch contacts, switch position contacts, and contacts of other important devices, are placed in series in the under-voltage circuit to give maximum protection.

   A memory type fault finding system is used to monitor important devices which operate only momentarily at the time of the fault condition. For example, the motor field loss relay may drop out only momentarily due to an intermittent failure in the field circuit. A contact on the field loss relay is used to trip the field loss annunciator, which sounds an alarm and energizes a light on the annunciator.

   Selector switch type fault finders are used to locate open contacts on devices that are manually operated or must be reset manually after tripping. This category includes knife switches, circuit breakers and self-maintained relays.

5. There is graphic indication of the distributor, large and small bells, and skip hoist operation, with duplication of indication in the hoist house and stockhouse.

6. Color coding is provided for all control wiring on the panels to distinguish different voltages and various functions.

7. There is ease and flexibility of selection of large bell dump, charging sequence and distributor angle change.

8. Factory mounted and piped solenoid air valves have been provided for the control of weigh hopper gates, nut coke gates and water charging valves.

9. Resistors and reactors are factory mounted and wired on top of control boards.

10. Separate circuits are supplied, protected by circuit breakers, for the 230-volt, d-c requirements, such as the skip hoist motor-generator set, synchronous motor field, distributor motor and control, hot blast control, high pressure top and bell hoist valve operator and skip hoist control.

11. Operating safety has been stressed by providing facilities to lock-out the operation at various locations.

12. Local operating panels have been provided at the various pieces of equipment. These panels are factory assembled and wired, and connectors are readily accessible for testing.

13. A static type of rectifier is provided for the skip hoist control.

14. The stockline winch mechanism is powered by a squirrel cage induction motor, and indicators and recording meters are built in a single unit for the stockhouse indicator panel and the pyrometer panel for each of the two stockrods.

15. The lights on the charging control have been color coded to aid the operator in using the indicator panels.

16. Facilities have been provided for the termination of incoming power and control leads behind the control panel, and racks have been provided for the horizontal support of the cables.

17. The scale car operator's desk and the stockhouse manual operation panel are so arranged that all indication is within sight of the operator.

18. Meters have been provided to indicate all quantities important to the operation.

19. All equipment insofar as possible has been factory mounted, assembled and tested to reduce the field labor to a minimum.

SUMMARY

The blast furnace charging control on the No. 3 blast furnace represents the combined efforts of operators, furnace designers and constructors and control engineers. It fulfills the requirements of blast furnace charging as the art is known to date.

Discussion

PRESENTED BY

M. E. MURPHY, Application Engineer, General Electric Co., Pittsburgh, Pa.

S. P. CURTIS, Chief Engineer, Fairless Works, United States Steel Corp., Fairless Hills, Pa.

R. F. SCHRAMM, Assistant Chief Engineer, Arthur G. McKee & Co., Cleveland, Ohio

D. W. FATH, Senior Electrical Engineer, Cutler-Hammer, Inc., Milwaukee, Wis.

M. E. Murphy: The author's detailed description of the charging control equipment furnished for the furnace, particularly the extent of indication available to operators and maintenance men, leaves little to the imagination. Without a doubt, these control panels will be spectacular in operation. The ease with which the scale car operator can follow the progress of the charging cycle should assist him materially in performing his function more efficiently.

However, while improved indication and monitoring of the charging cycle are highly desirable, we believe that advances of even greater importance toward increasing furnace output can be made in the control system itself, in at least two ways.

1. *Circuit component reliability.* The control system described by the authors utilizes conventional relays, latch-in relays, and motorized sequencing switches as has been done for many years in the past. The control thus depends upon hundreds of contacts for physically switching the circuits. Although these relay systems have proved to be quite reliable, each set of contacts is a potential source of trouble, and it is desirable to strive for even greater reliability. We believe that static switching components should be used to perform the functions which the relays and sequencing switches now perform in this critical application. These static switching devices perform their function without moving contacts of any sort, and are unaffected by atmospheric conditions. We believe the reliability of blast furnace charging control will be greatly improved through the use of these devices, and we are currently offering this type of control for blast furnace installations.

2. *Further automation of the charging cycle.* To the best of our knowledge, to date a completely automatic charging control does not yet exist. Only the charging of coke is fully automatic. The charging of ore, scrap, and stone are only semi-automatic operations, in that the scale car operator must first take note of the next required charge in the cycle as shown on the control panel, move the scale car to the correct storage bin, load and return the car to the skip pit, and manually initiate dumping of the load into the skip. He is then also required to start the skip after loading ore or stone. We believe that automatic loading of stone, ore, and scrap in addition to the automatic loading of coke would not only permit faster charging rates but would result in much better control and greater uniformity of the charge. This should ultimately allow a better control of the quality of the iron produced. One way to accomplish this for a new installation would be by means of a conveyor system which would pre-weigh and automatically charge ore, stone, dolomite, etc., as programmed by the charging control. For existing installations, however, space limitations might rule out such a system. In this case, it would be possible to program the operation of the scale car, although we consider this as a much less flexible system than a conveyor system. As the charging control becomes more completely automatic and more elaborate, static switching becomes even more attractive.

Would the authors care to comment on these points?

S. P. Curtis, R. F. Schramm, D. W. Fath: The suggestions made by Mr. Murphy have merit. We believe that static switching has a place in the development of the charging control, and we accordingly plan to give it full consideration when future furnaces are built.

As for complete automation of the charging cycle, this is indeed a goal worth striving for. Considerable engineering has been done to determine both the practical and the economic aspects of such a system, but to date the overall benefits have not appeared sufficiently attractive to warrant such an installation. It must be remembered that the modern blast furnace needs only one man in the stockhouse. In addition to performing routine functions, this man must exercise judgment to maintain proper operation. For example, ore is notoriously difficult to handle when wet, and the scale car operator, as part of his normal duties, will take the necessary steps to get the ore out of the bins. We do not believe that the time has arrived when we can permit the raw material charging to proceed completely unattended. ▲

A New Combustion Process for Temperature Uniformity in Heat Treating Furnaces

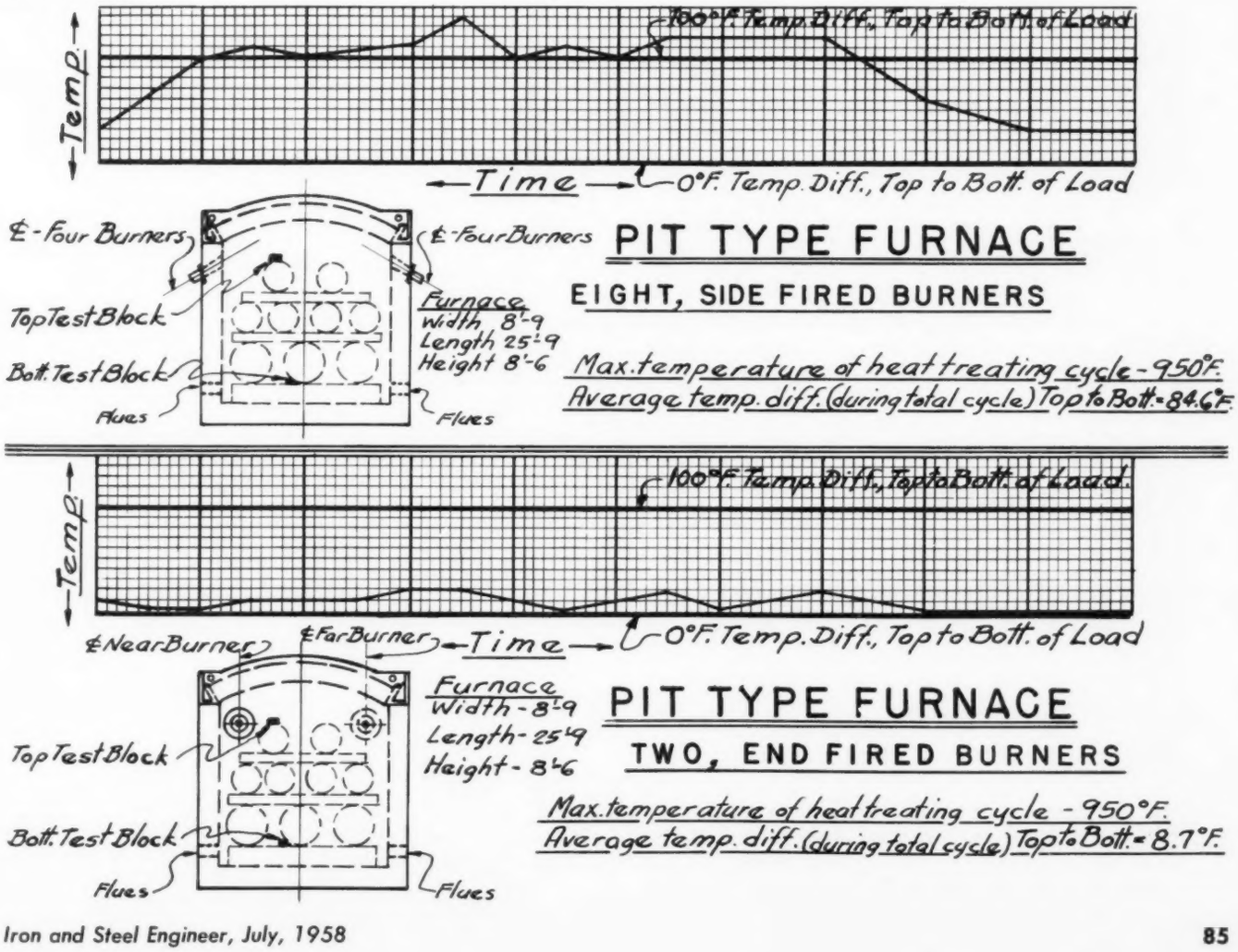
by F. C. T. Daniels, Consultant, and Steve Stasko, Assistant Chief Engineer
Mackintosh-Hemphill Div., E. W. Bliss Co., Pittsburgh, Pa.

Burners designed to use excess air have given improved temperature uniformity and control . . . . outstanding features are circular heated air motion, positive furnace pressure and forced convection.

OPERATORS of heat-treating furnaces are continually faced with the problem of attaining temperature uniformity and temperature control. In shops where mass is a major consideration, the establishment of heating rates is critical. The problem is amplified by the internal stresses which may be created during the heat-treating cycle. It is true that uniformity and control of temperature is important in any heating operation, but losses, in terms of scrapped or defective product, rise much more rapidly when uneven temperatures occur within a load of large cross-section castings or forgings.

For many years, the most popular type of combustion system on car, pit and cover type furnaces consisted of a series of burners along the length of the furnace at hearth and roof levels with some furnaces containing dozens of burners. In order to increase the temperature in these furnaces, a continual increase of fuel and air is required at each burner area, but the fuel and air are only supplied at theoretically complete combustion

Figure 1 — Charts compare temperature measurements between the two furnaces. Notice smaller variation indicated on lower chart.



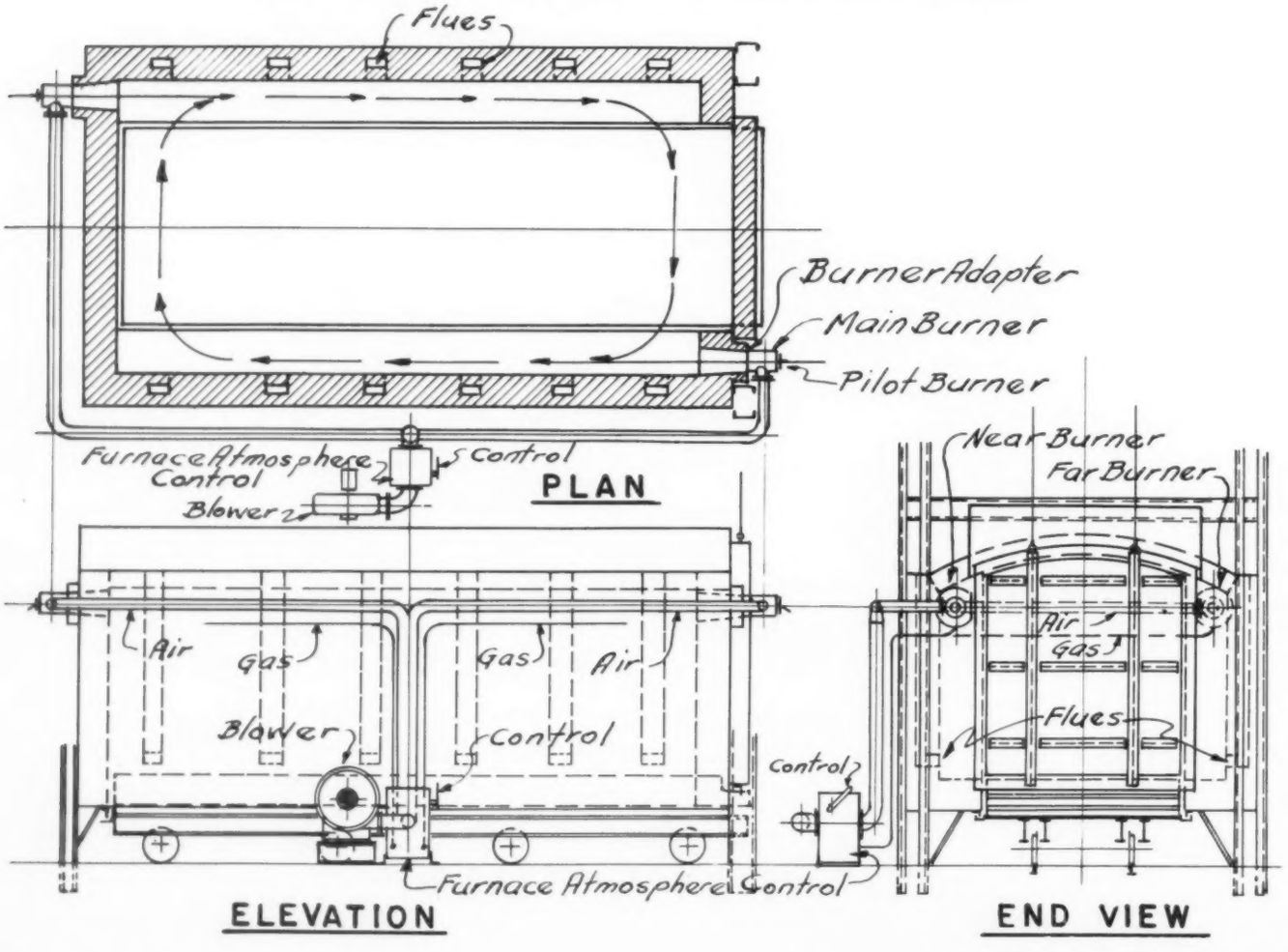
levels. This often results in areas in the immediate vicinity of each burner becoming extremely hot since most of the heat transfer is of the radiation type. Other parts of the load may, however, be relatively cold since neither conduction nor convection can counter the radiation effects except with extremely slow heating rates. Quite often these hot areas near the burners and relatively "dead" areas at points in the furnace most distant from the burners, show a considerable difference in temperature; in some cases as much as 100 F. For heating to quench in steels, this means a longer hold time waiting for the temperature to become uniform as well as the abuses the material has already been subjected to through nonuniform heating.

Early in 1950, our company recognized certain possibilities in a new combustion process which had been brought to their attention. A comparison was made of the effectiveness of the new process (Figure 1) with that of eight side fired burners in a pit type furnace. A test block was placed on the top of each load and one at the bottom of each load in the two furnaces. Thermocouples were connected to each of the blocks. The maximum temperature of the heat-treating cycle in both cases was 950 F. The average temperature difference, top to bottom of the furnace, during the total cycle for the side fired furnace was 84.6 F. The maximum difference at any one time amounted to 140 F. The furnace equipped with two of the new burners showed an average temperature difference, top to bottom of the load, of 8.7 F with the maximum difference at any one time of 20 F.

The success of the new process depends mainly upon the use of excess air in quantities above that which is theoretically needed for complete combustion of the fuel. The air is supplied through the burner in such a manner that only that small portion necessary for combustion is mixed with the fuel. Most of the air is passed around the flame so it mixes with the heat of the flame at a point within the burner tunnel. The use of excess air creates a greater volume of gases in the furnace at a higher velocity which naturally increases the rate of convection. The resulting mixture possesses a temperature which is lower than if no excess air is introduced, and the theoretical ratio for complete combustion is maintained. This means a slight increase in the amount of fuel used, a disadvantage which is more than offset by the benefits of temperature uniformity thoughout the furnace.

The heated excess air is introduced at the top of the furnace through burners which are placed at diagonally opposite corners of the furnace to fire along the longer walls. The burners are also located high in the furnace, just below the roof section, to introduce the heat over the load at the highest convenient point. This placement of the burners, high in the furnace end wall, permits the heated mixture of excess air at high velocity to assume a circular motion over the load. The great volume of gases resulting from the introduction of the excess air creates a positive pressure condition which forces the circular moving air downward through the

Figure 2 — In the car type furnace the burners can be located beside the door.



furnace and out restricted orifices at the bottom. The burner placement minimizes the amount of direct radiation from the flame to the load, making the flame-excess air mixture temperature the highest in the furnace. Thus no point on the surface of the load can be any hotter than the mixture temperature, and with the furnace operating under a positive pressure, the entire load is uniformly heated.

The two burners are regulated from one point, the furnace atmosphere controller. The controller is located approximately midway between the burners along the longer furnace wall. Control of furnace temperatures is easier by regulating fuel and air in any proportion at this one point. The amount of piping to the burners is minimized with the new process equipment. The system is also monitored by approved safety devices.

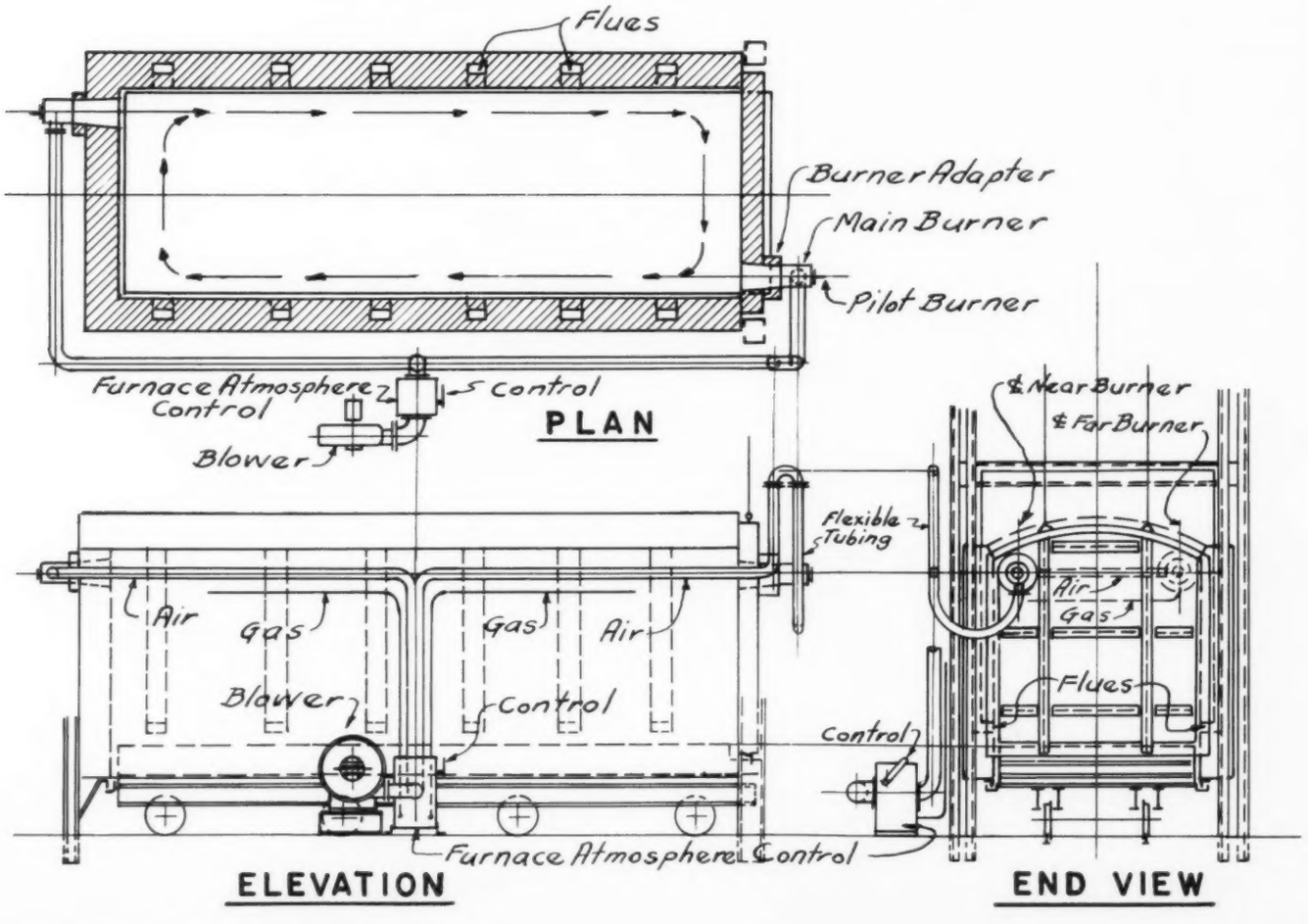
When lower temperatures are desired with the burner, increased amounts of excess air are used. Thus greater pressures are provided within the furnace to prevent cold air from leaking in through the flues at the bottom of the furnace. This ability to control and maintain uniform temperatures is extremely important during the cooling phase of the heat-treating cycle. As temperatures drop to approximately 500 F, heat is lost so slowly that a 10 F per hr drop is not unusual. If the burners are off and the furnace at negative pressure, cold air leaks in through the openings cooling the bottom but not the top of the furnace load. In treating high alloy materials with low start of martensite transformation temperatures, this can be a serious problem. Forced cooling is possible with the new combustion system by using the heated excess air to speed up the cooling cycle thereby increasing furnace turnover and to prevent infiltration of cold air by maintaining a positive furnace pressure.

For temperature below 1000 F, no visible flame passes beyond the burner tunnel, just a stream of heated air under positive pressure. At approximately 1750 F, a slight luminosity is visible. As higher temperatures are desired, from 1000 to 2300 F, the amount of excess air is gradually decreased until its value approximates only a slight excess over the theoretical requirement for combustion. At these higher temperatures the burners can be adjusted to provide a neutral atmosphere. To prove that this condition existed, a demonstration was conducted with a burner firing into a small melting furnace. When the furnace was almost up to 2500 F, a $\frac{3}{8}$-in. low carbon steel rod was inserted through a hole in the top of the furnace. The rod soon started to melt and dripped without sparking thus indicating a nonoxidizing atmosphere.

The use of the new combustion process to improve temperature uniformity and control is applicable in the temperature range of 200 to 2300 F. It lends itself well to operations in which the furnace must be operated at high temperatures during part of the cycle, and at low temperatures during another. It is particularly adaptable for use in heating articles such as large castings or forgings which require a slow heating rate with near perfect temperature uniformity.

Some of the applications to which the combustion system has been applied are as follows: In a car type

Figure 3— For narrow furnaces the burner is located on the door.



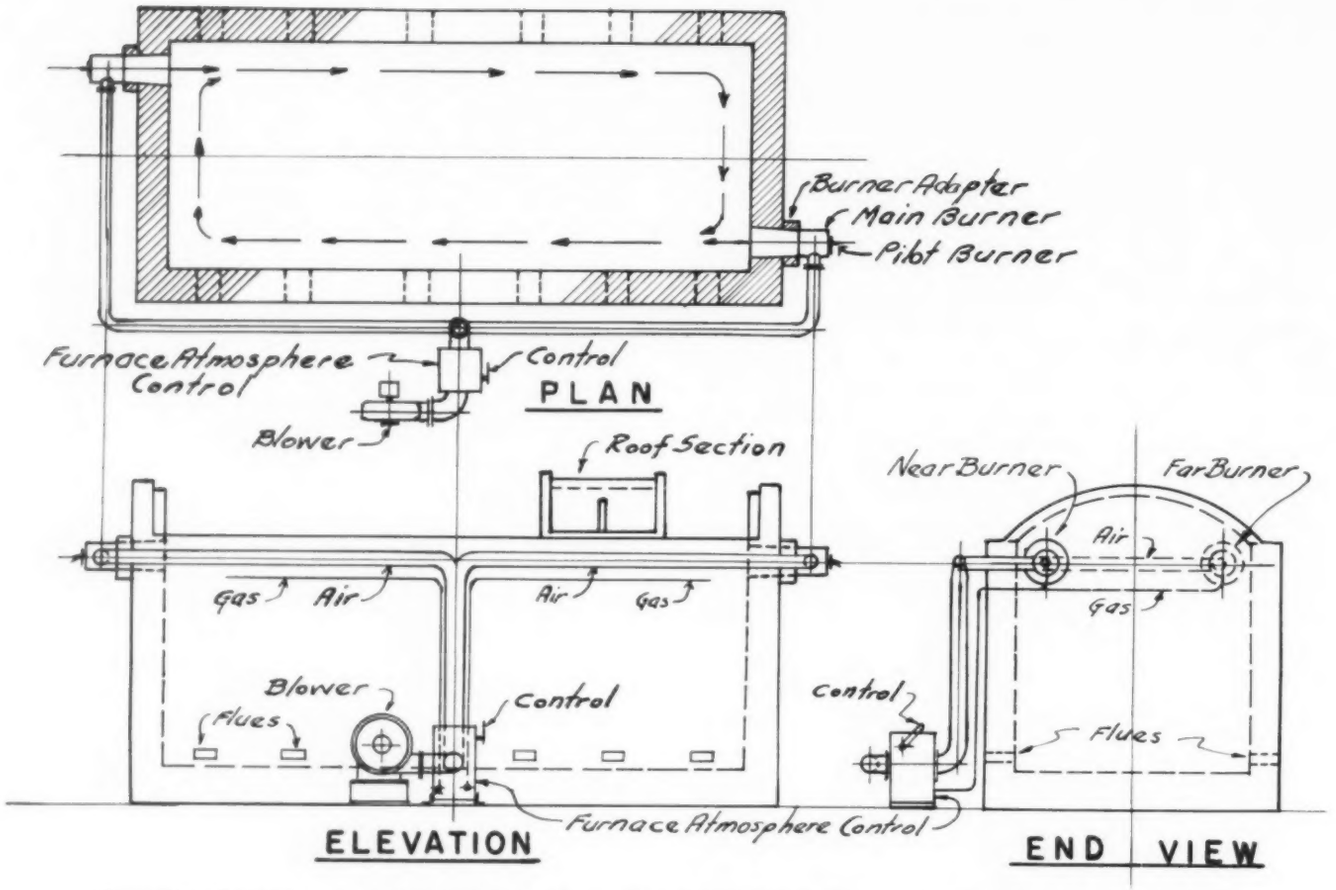
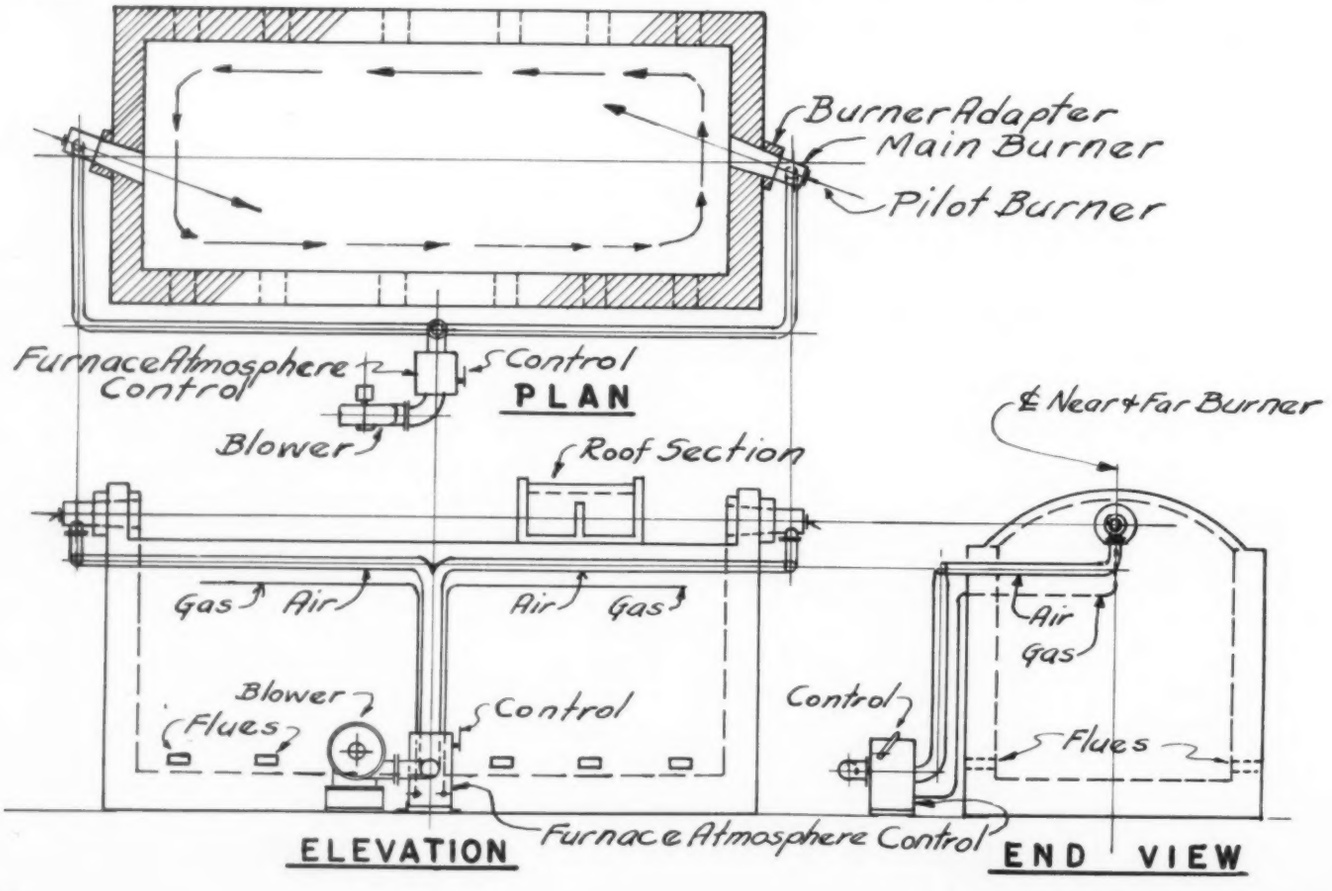


Figure 4 — In pit furnaces, burners can be located in diagonally opposite corners just below roof section.

Figure 5 — Burners may also be located high in the center of the end walls which prevents intimate contact of flame with charge.



furnace (Figure 2) where the width of the furnace is sufficiently greater than the buggy, the burners can be located beside the door and remain stationary throughout their life. For the narrower furnaces (Figure 3) where the door covers practically the entire width, one burner is located on the door. Flexible tubing is used to connect the burner to the controller. The tubing must be supported high above the burner when the door is closed so that it will not interfere with the removal of the car and charge when the door is opened. Other than the flexible tubing, the arrangement of the burners and controller are the same as previously described. Pit

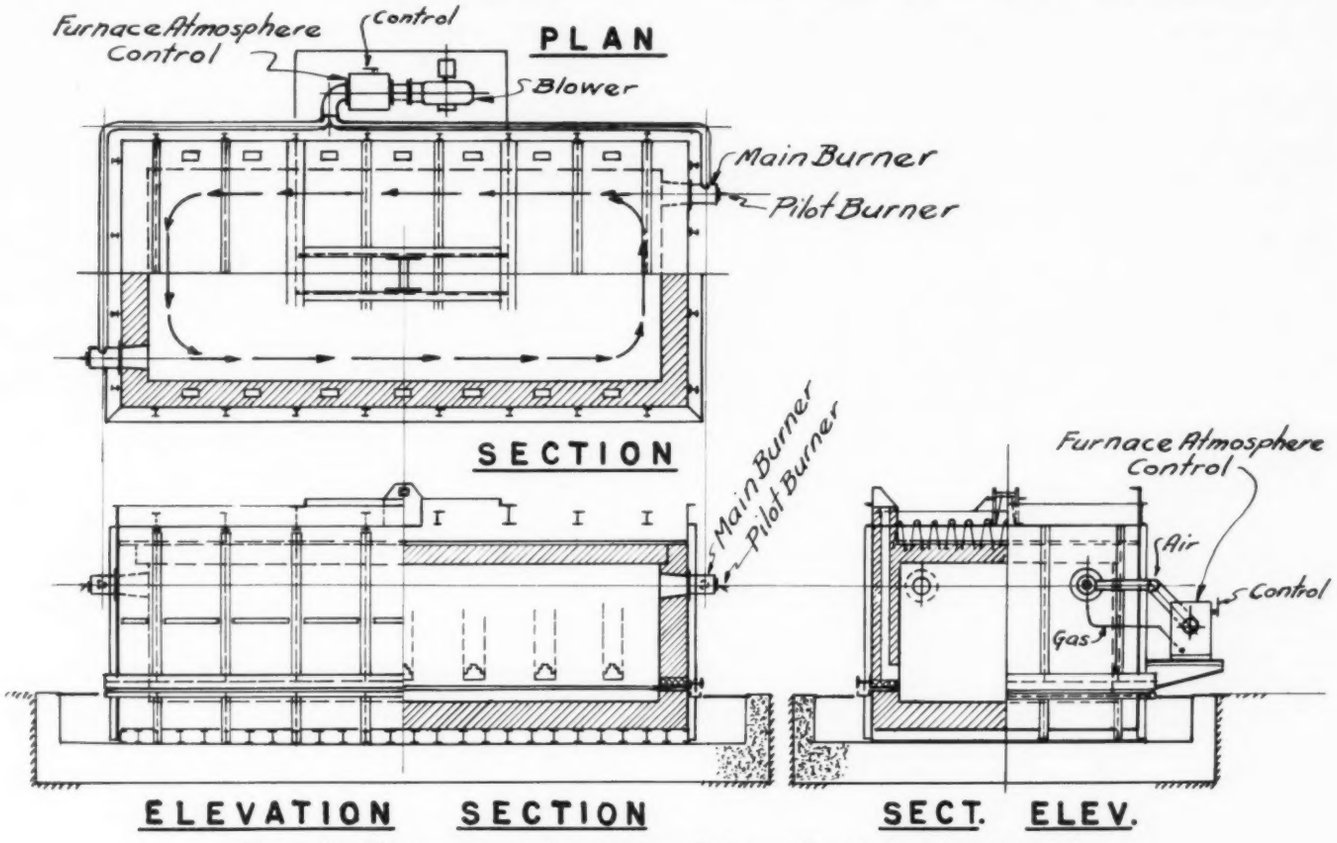
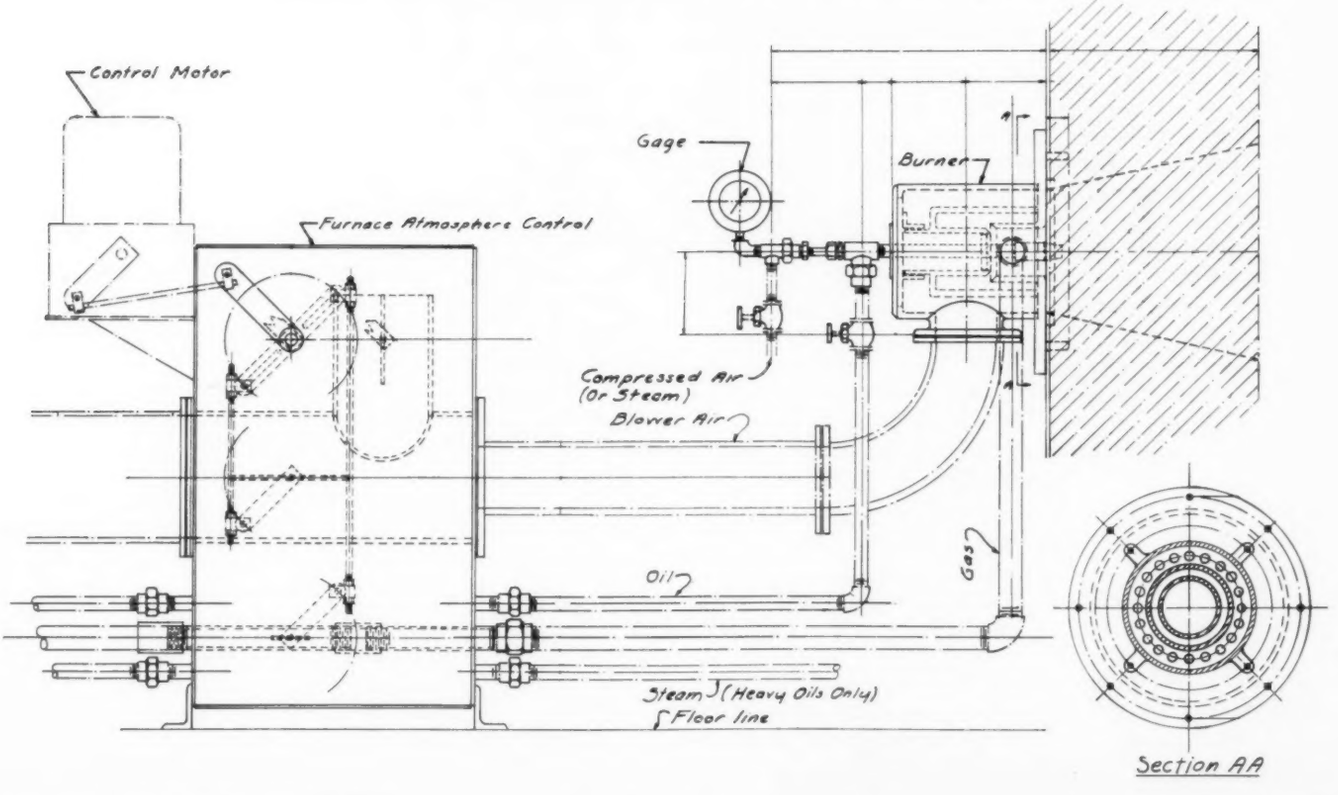


Figure 6 — The same general arrangement also applies to cover type furnaces.

Figure 7 — Schematic shows furnace atmosphere control and combination gas and oil burner.



type furnaces (Figure 4) can be outfitted in the same manner as the car type with the burners in diagonally opposite corners just below the roof section. The atmosphere control and blower are still in the center of the long dimension wall with the flues at hearth level. A variation of burner arrangement (Figure 5) for a pit type furnace, locates the burners high in the center of the end walls but at an angle to fire toward the long wall immediately under the roof section. This prevents any intimate contact of the flame with the charge while still allowing full use of the entire furnace. The same general arrangement (Figure 6) applies to cover type furnaces. Two quick disconnections of the gas and electrical lines permit the entire system to be raised with the cover. Figure 7 shows burner and atmosphere controller.

The new combustion process has also received extensive application in mold drying operations. Drying sand molds in iron and steel foundries often requires ovens with rather high elevations to accommodate flasks and chillers stacked one on another. Temperatures in these ovens seldom exceed 700 F, therefore the same excess air-positive pressure principle of the process equipment provides improved temperature uniformity throughout the furnace to insure adequate moisture removal. Rapid and effective drying is easily accomplished.

In conclusion, the salient features of the new combustion process to attain improved temperature uniformity and control are circular heated air motion, positive furnace pressure and forced convection. Control of the fuel-air ratio for both burners is simplified through the use of the furnace atmosphere controller. In the author's opinion, the new combustion process can be applied in any heating or heat-treating operation which requires the optimum in temperature uniformity and control within the range of ferrous heat-treating temperatures.

Discussion

PRESENTED BY

M. H. MAWHINNEY, Combustion Engineer, Crucible Steel Company of America, Midland, Pa.

STEVE STASKO, Assistant Chief Metallurgist, Mackintosh-Hemphill Div., E. W. Bliss Co., Pittsburgh, Pa.

J. H. KLINK, Combustion Specialist, Heating Dept., General Electric Co., Shelbyville, Ind.

C. E. PETERSON, Manager of Manufacturing Operations, Mackintosh-Hemphill Div., E. W. Bliss Co., Pittsburgh, Pa.

W. ROBERT STAMM, Mechanical Engineer, Bailey Meter Co., Pittsburgh, Pa.

C. GERDING, Project Engineer, Edgewater Steel Co., Oakmont, Pa.

G. W. HECK, JR., Chief Metallurgist, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.

M. H. Mawhinney: Only two comments occur to me in connection with the interesting paper which has been presented. One is that to convince skeptical combustion engineers of the merit of any all-purpose and new arrangement of firing might require considerably more factual evidence than was possible to include or was included in the paper.

The other is to wonder how this method of heating will compare with other modern methods which have been devised for heating of furnaces. The only reference made was at 950 F, where previous to about 1931, combustion chambers were used with indirect firing, so that the burners did not see the work; and after 1931, of course, convection heating was almost universally used, where, again, the burners are entirely separate from the heating chamber, and where the circulation of gas is on the order of 10,000 to 12,000 cfm for each million Btu per hr fired.

The purpose of this more modern method of heating at these low temperatures is to attain uniformity all over the furnace in the order of plus or minus 5 F. The author does not state what quantity of gas was circulated per million Btu's fired in the furnace mentioned, and therefore it is difficult to compare the probable uniformity with the modern types of furnaces.

At the very high temperatures mentioned of 2000 degrees, it is probable that radiation is active enough that uniformity would be achieved by such burners without difficulty. Additional trouble might be experienced, in my opinion, at intermediate temperatures of heat-treating of 1500 or 1600 F where radiation is much less than at the higher temperatures, and where the location of a few very large burners at the top only of the furnace would seem to me to cause some difficulty in the uniform heating at the lower temperatures with the amount of circulation that is possible with the standard excess air burner.

Steve Stasko: Mr. Mawhinney's figures are fundamentally correct. His comparison of the subject of this paper to what is possible by the use of a recirculating system is out of focus.

We have found that this combustion process does provide uniform furnace temperatures at the lower temperature ranges (200 to 800 F) while using air to gas ratios of 20,000 to 30,000 cu ft of air per 1,000,000 Btu's fired. At temperatures above 800 F the furnace atmosphere control continues to regulate the ratio of air to gas by progressively diminishing the amount of excess air until the ratio approaches the theoretical of 10,000 to 12,000 cu ft of air per 1,000,000 Btu's fired.

The Btu-rating of any given size burner is misleading because its Btu capacity is directly related to the amount of air being passed through it, at different pressures. As an indication of the existing conditions within the burners used in this combustion process, when using 60 per cent excess air (air to gas ratio 16 to 1) each burner is flowing 2500 cfh of gas and 40,000 cfh of air and maintaining a uniform furnace temperature of 1550 F.

We do not question Mr. Mawhinney's statements as to the amounts of air per 1,000,000 Btu that can be circulated in a recirculating furnace. However, it has been our experience that in our system, three to four times the amount of air required for perfect combustion is amply sufficient to produce, even at very low temperatures, the desired results, namely, enough volume at the necessary velocity to effect very high uniformity and positive pressure.

J. H. Klink: The use of excess air on many direct-

fired furnaces is a useful tool for improving temperature uniformity. This is especially true where production requirements dictate a furnace that will operate over a very wide temperature range, such as described in this excellent paper. However, there are several conditions which greatly influence the effectiveness of an excess air system.

For instance, consideration must be given to the type of furnace, load shape and size, and especially the required temperature cycles. To achieve a maximum temperature difference of only 20 F during the heating of a large load, at a fairly rapid rate, would require large percentages of excess air to maintain a small temperature differential between flame temperature and load temperature. Considerable additional fuel would be required to heat this air.

For low temperature application (below 1400 to 1500 F) we feel the economy of operation justifies the additional cost of an external recirculating, forced convection, fan system. With this system the burners are operating on ratio at all times. Also, much higher volumes of recirculated air can be obtained.

I would appreciate any comments the authors care to make on the application of the recirculating system vs the excess air system.

Steve Stasko: On the whole, the comments which I presented at the offset of the discussion period apply equally well to Mr. Klink's request for a comparison of the recirculating system and the excess air system.

Field tests were conducted initially and a continuous program is in existence to ascertain the degree of uniformity in all of our heat-treating furnaces since we know furnace temperature uniformity is paramount during the heat-treating phase of the manufacture of high quality rolling mill rolls.

C. E. Peterson: I would like to make one comment on the cost of installing a recirculating furnace. With all of the extra equipment needed for a separate firing chamber, the cost of a recirculating furnace is a great deal higher than the cost of a standard furnace equipped with special burners which will accomplish the same purpose. Thus the capital investment is a great deal less with these new process furnaces.

Insofar as the effect is concerned, once you get the furnace built, there is probably not a great deal of difference, particularly in the low temperature region. The rate of heat input with the special burners is adequate for all large section pieces, since all practical heating rates are relatively slow anyway, and high Btu input is of secondary importance compared to uniformity of temperature. Unfortunately, with the recirculating furnace, the temperature range is generally limited to the low temperature heat-treating cycles, but with this new type of furnace, you are not limited to any specific temperature range.

W. Robert Stamm: What range of excess air is involved in the furnace; I do not believe that was mentioned, also, what is the order of magnitude of furnace pressure? I would be interested in a description of the so-called atmosphere controller.

Steve Stasko: The range of excess air is in the order of magnitude of 30,000 cu ft of air per 1,000,000 Btu's fired at the low temperature range while at the higher temperatures the amount of air has been reduced to the theoretical 10,000 to 12,000 cu ft of air per 1,000,000 Btu's fired.

In regard to the magnitude of furnace pressures employed, I can say nothing more than positive pressure is evident at the flue openings by the rapid egress of hot flue gases at these points. I have no quantitative data to offer.

The so-called atmosphere controller performs a simple metering function which permits the control of the fuel to air ratio for both burners to be made at one location. Figure 7 is self explanatory.

C. Gerding: In answer to the question about pressure in excess air fired furnaces, we have found it good operating practice to damp the furnace down to the point where some positive pressure exists at the hearth (at low fire). You will normally not need any greater pressure than that—at least not in the usual heat-treating applications we are familiar with.

It is our experience that if you have zero plus (say 0.05 in. of water column) at the hearth, no greater pressure will do you much good.

Member: Does excess air create excess odors?

Steve Stasko: To the best of my knowledge, this has never been a problem in our shops. Is there anyone who cares to comment on this point?

C. Gerding: In answer to the question concerning the odor from excess air burners, we have installed several furnaces of the excess air type at Edgewater using different brands of burners, and it seems that the odor is a function of the particular burner used as well as the temperature to which the flame is diluted by excess air. (Our experience indicates that odor is a result of how mixing and combustion proceed within the burner. If the fuel entering the burner is allowed to burn with about the correct amount of air for complete combustion before being diluted with excess air, odor will be minimized. If, however, the partly reacted flame is quenched by too much excess air introduced too soon, odor will probably result.)

M. H. Mawhinney: I do not think we should try to compare excess air burners with a recirculating furnace.

The firing of one million Btu of any fuel requires 10,000 cu ft of air. To circulate the amount that is circulated in circulating furnaces would be sixty times that. No excess air burner puts in 60 times the necessary amount of air. It might put in as much as four times. Therefore, the recirculation type furnace has 15 times the circulation that any excess air burner furnace can have; so I do not think you should try to compare the two at all.

G. W. Heck, Jr.: The paper by Mr. Daniels and Mr. Stasko has been reviewed and their statements are in agreement with our own experience with the new combustion process. Their description of the system and its operation needs no amplification.

We have been operating the new combustion process for the past fourteen months on a furnace equipped with fully automatic control. The furnace has covered heat-treating temperatures ranging from 450 to 2000 F. Heating and cooling rates have varied from 25 F per hr minimum to 300 F per hr maximum.

Definite advantages found with the new process are low maintenance of burners and furnace, ease of adjustment for the various heat-treating cycles, and absence of hot and cold spots in the furnace. ▲

Some Practical Solutions to Hot

by R. A. Smith,
Assistant General Foreman
and A. D. Patton,
Assistant to General Foreman
96-In. Hot Mill
Pittsburgh Works Div.,
Jones & Laughlin Steel Corp.
Pittsburgh, Pa.

Improvements in mill operation are largely the result of keen observation and accurate, practical analyses of many details in the mill . . . . changes in any one item often require additional changes in other facets of mill operation.

THE ever-increasing demands for improved products, produced by the modern continuous strip mills, require the operator's constant vigilance and attention to even the smallest details. Competitive conditions today make it absolutely necessary that every phase of steelmaking from the raw material down, be minutely supervised if rejections are not to be completely out of line and cost and performance records poor. Uniform soaking to the correct temperature is essential, both in soaking pit and reheating furnace practice.

The competition and demands are such that operating problems are constantly mounting. This presentation will discuss several of the many problems, along with some of the practical solutions.

The hot strip mill located at the Pittsburgh Works is a 96-in. continuous strip mill, constructed in 1936 starting operations in the early part of 1937. The mill was designed primarily for the production of hot rolled bands for tinplate, hot and cold rolled sheets and carbon plates. Today, the product has been expanded to include hot rolled bands for a newly developed galvanizing plant, high tensile plate, armor plate, and stainless steel hot bands. The size and section produced includes 22-in. wide up to and including 90-in. wide finished material, in gages from 0.048 (18 gage) to and including 0.750 (¾ in.) plate. Heavier gage plate is produced; however, this being limited to small tonnages of armor plate, some production orders and interdepartment orders. The equipment consists of three triple-zoned recuperative slab heating furnaces, two scalebreakers, four roughing stands, six finishing stands, two rotating mandrel type coilers, and the necessary complement of finishing equipment to produce a finished product.

This is not the only strip mill having problems; however, our 96-in. mill must be quite versatile due to the variety of commodities being produced and therefore the problems are greatly multiplied. Due to the present market conditions and the steadily rising operational costs, the steel industry has found it necessary not only to develop improved methods in processing, but to make the inevitable changes in existing equipment in an effort to remain competitive. The problem of increasing production and maintaining costs to a minimum is an old axiom and is merely repetitious; nevertheless, there is no escape—like safety, the job is endless.

THE FIRST PROBLEM

The greatest problem was to increase the mill production. At first, it was believed that this could be accomplished merely by increasing the average slab weight. The inside width of the furnace being 216 in., we had already been employing a maximum slab length of 190 in. which we felt the furnaces could safely accommodate.

The only way that slab weight could be increased would be to order thicker slabs. This was done—the thickness was increased to the maximum that could be handled or broken down on the mill, however, having but three furnaces, we found in many cases this increase resulted in furnace bottle-neck material. In other words, the capacity of the mill was greater than the output of the furnaces. In this connection, we also felt that the quality of our product was being sacrificed, for these heavier slabs were not being uniformly heated and thoroughly soaked. This problem had to be solved!

After many meetings and discussions among the strip mill personnel, the following plan was considered most feasible. This involved the widening of the furnaces so that the slab length could be increased while the undesirable thickness could be eliminated. However, this was looked upon as a costly major job. It meant practically a complete rebuild of refractory work as well as a major change in the structural design. A thorough investigation, however, was made as to the possibility of reducing the wall thickness; thereby increasing the

inside dimension of the furnace. In order to do this, it was necessary to find a refractory with a higher thermal efficiency than that of refractory brick. After further meetings with our combustion and refractory personnel it was felt that a monolithic structure would do the job. This was further developed with the sales engineers dealing in plastic refractory.

As a result of these meetings, a 10-in. side wall was suggested, consisting of 7½ in. of plastic refractory, backed by 2½ in. of block insulation, in place of the present 18-in. refractory brick wall. If this should prove satisfactory, the inside furnace width could be increased from 216 to 232 in. This would permit us to change the maximum slab provision length from 190 to 206 in. This additional length could be obtained without affecting the established yields and practices at the open hearth and blooming mills, and still permit a reduction in average slab thickness.

This proposal was presented to management for their consideration, with approval being given for the installation of a test patch, to be installed in the hot zone of one of the furnaces. After many months of operation and observation, we felt confident that the plastic refractory had the insulation value, mechanical strength and resistance to combustion velocities to perform the job. Since the initial installation, 10-in. side walls have been installed in all three furnaces and have proven most satisfactory. We believe that through the use of plastic refractory we have improved the furnace efficiency, reduced fuel costs and increased production.

THE SECOND PROBLEM

The next problem, directly concerning our furnaces, was that of reducing the operating outage time. We were experiencing considerable downtime due to making numerous minor weld repairs to the longitudinal or slab carrying skid pipes. As a general rule, it was necessary to renew these skid pipes once every ten to twelve months. To be more specific, we could expect numerous pipe breaks anytime after seven months. On these occasions, it was often necessary to immediately shut down the furnace and make the necessary repairs. The operating outage, as a rule in this case, would mean taking the furnace out of production for as much as twelve to sixteen hours. In this case, along with the production loss, there were many instances whereby we encountered refractory damage due to application of fog sprays to expedite the cooling of the furnace. If the fog sprays were not used, we could expect much longer outage time as workmen are not permitted to enter the furnace until it has reached a safe working temperature. As a safety precaution, the welders and pipefitters making the repairs are provided with safety clothing made of aluminized asbestos material. The outfit consists of trousers, full length coat, hood and gloves. The use of such equipment has minimized the relief necessary when performing hot jobs. In some cases if the leak was of minor nature, the furnace was operated until the regular scheduled repair time and this would reduce the loss of production.

Basically the problem of breakage was caused by various reasons. One was the acid content of the river water, the others were due to vibrations, normal expansion and contraction resulting from varying temperatures and also in some cases, due to abrasive wear. In order to reduce the acid content of the water, it was necessary to make lime additions at our pumping stations. This helped somewhat but we were still encountering breakage.

At this time we were using 2½-in. double XX seamless pipe. It was suggested that 3-in. triple XXX pipe might extend the life and also reduce the breakage. We were primarily concerned with this increased wall thickness, that perhaps, the volume of water passing through would not sufficiently cool the pipe, and if this were the case, we would indeed be in more serious trouble. However, during the course of meetings with the combustion and engineering departments, we were assured that proper cooling would be obtained. Therefore, we made the substitution on the next rebuild and since then have made this change to the two remaining furnaces.

The initial change was made in November, 1955 and to this date we have encountered absolutely no breakage. During the last refractory rebuild, which was in January of this year, the only repairs made to these 3-in. triple XXX pipes was some necessary building up of wearing rod by welding. We cannot at this time predict their expected life, nevertheless the additional cost has already more than paid for itself.

THE THIRD PROBLEM

Recently, the numerous inquiries concerning heavy gage coiled plate for line pipe prompted an investigation as to the possibility of our participation in this business. As for the rolling equipment, there appeared to be no problem; however, the many specifications for various grades of line pipe are such, that we in the operating department as well as the metallurgical department realized that it would be impossible to produce this product with the present quenching system. The run-out table quenching spray system, which had proven satisfactory for the present materials being produced, consisted of fifteen top sprays and thirty bottom sprays.

The water supplied to these sprays was taken from a reservoir located under the run-out table. There are two pumps, one a 2500-gpm pump delivering to the top sprays, approximately 30-psi pressure and a 1500-gpm pump delivering to the bottom spray approximately 60-psi pressure. Realizing that additional quenching would be needed on this heavier gage product, we installed nine additional top sprays. Several trial rollings showed that although our top pressure dropped to 20-psi pressure, a slight drop in the coiling temperature was possible. This drop in temperature was primarily the result of the spacing of the sprays which permitted longer contact time between the strip and the water. We then realized a need for greater volume and higher pressures to obtain the necessary coiling temperatures.

In order to obtain the necessary volume and pressure,

Mill Problems

another pump would be required, one of much greater capacity than the existing pumps. It was thought that an additional 5000-gpm or 6500-gpm pump would do the job. We then looked to the possibility of using one of our two present 6500-gpm pumps intended for roll cooling. Knowing that the mill loads would not be too heavy on this product and also that the contact time with the roll was short, the single pump would prove sufficient for the roll cooling.

The next approach was to divert the water from one of our 6500-gpm pumps to the run-out table quenching system. We installed necessary valves and piping to deliver this water to the top sprays.

In order to give the metallurgical department better control over the cooling temperature of the various gages and grades, the 6500-gpm pump was piped to the original fifteen top headers while the 2500-gpm pump fed the new nine top sprays. To further this control, we also grouped the fifteen top headers in zones of five each. These were automatically operated so that one zone or a combination of zones could be used as needed.

With the use of the third pump, pressures were increased to 50 to 75 psi, depending upon the number of headers being used. The pressure on the new nine top was increased to approximately 50 psi. With this increase volume and pressure, we have been satisfactorily producing line pipe for various customers.

THE FOURTH PROBLEM

The problem of increasing roll life is the next topic for discussion. This problem has plagued us since the mill began operations and has become a more serious problem as production was increased. With this increased production, we experienced considerably shorter roll life. The total tons, produced per average life of a set of rolls, were lessened due to frequent roll changes and the subsequent reductions taken in the roll shops when conditioning these rolls. In order to produce a competitive product, it was necessary to change rolls quite frequently because of wear. This condition was brought about through the longer roll contact time, greater build-up of heat in the rolls and the resulting burning off of the roll surface.

The problem has been to improve the distribution of the water and also to increase the water pressure being applied to the rolls. Prior to the beginning of operations, it was believed that normal service water line pressure (40 to 45 psi) would be sufficient for roll cooling. This pressure was developed at our strainer intake; however, with the line loss, the pressure at the mills was never over 35 psi and often times dropped as low as 24 psi.

As time went on we realized that changes or developments would be necessary. The first step we made to overcome this problem was to reduce the volume of water on the last three finishing stands in order that more volume and water would be available for the first three finishing stands. Since the temperature of the steel passing through the first three finishers is highest at this time and also because of the heavier reduction loads, it was apparent that this change was a move in the right direction. This change was made through the installation of an orifice plate in the headers, leading to these individual mills. This offered some relief but the pressure as delivered to the mills was still not sufficient.

We then purchased and installed two 6500-gpm pumps capable of delivering 105 psi of pressure. The one pump was in operation constantly while the other was carried as a standby unit in case of a failure. With the use of one pump, we were able to develop 55 psi on the first three finishers and 48 psi on the last three finishers.

We previously mentioned our greatest problem was to increase the mill production and the first thing that was done was to increase the slab weight to the maximum that could be handled on the mill. With this increase in slab weights and resulting increase of operating loads, the pressures as developed by the one pump were not sufficient to cut the film of steam built up on the rolling pass. It was necessary then, to operate both pumps simultaneously. This brought about an increase in pressure to 105 psi, on the first three finishers and 85 psi on the last three finishers.

If a failure were encountered to either pump, there is no question in our minds that there would be a serious loss in production due to insufficient roll cooling water. Along with this loss in production, if a pump was not available for the run-out table quenching sprays when rolling heavy gage coiled product, the physical properties could not be made; also the nonuniformity of grain structure resulting from coiling too hot, would have a very serious effect on the drawability or ductility of many cold rolled drawing quality steels. We have recommended that management approve an appropriation for the purchase and installation of a third pump. It is our intention to install this pump as a standby unit which can be used for roll cooling or run-out table quenching.

In regard to distribution of water, it is necessary to make different applications, As mentioned earlier, the mill produces 22 to 90-in. wide finished product and it is apparent that different spray setups would have to be used for narrow and wide strips. The long and narrow strips require an additional spray covering the rolling pass because of the longer contact time in that particular part of the roll, whereas on the short wide strip, it is often necessary to eliminate the center spray in order to build up a little heat for reasons of shaping the finished product. Individual valves were installed in order to control the operation of these sprays as required.

Orginally the roll cooling spray pipes were made up of 2-in. pipe with ¼-in. holes drilled on 1¼-in. centers. These proved inefficient as numerous hot streaks built up on the rolling pass which caused, in time, the so-called banding of the roll. This banding of rolls, on cold rolled products, is very objectionable from a standpoint of surface requirements. If a banded roll is allowed to remain in the mill, in time the surface of that roll will pick up scale, formed on the strip through normal air cooling, and this scale build-up will be imparted and imbedded into the surface of the strip. This is what is known as rolled-in scale from worn out rolls. In order to eliminate this condition, an improvement in the water distribution was made, employing various types of spray nozzles, inserted at different centers. Presently we are using ¼-in. V-jet nozzles on 2-in. centers and have found them very satisfactory in the uniform distribution of water.

The changes we have developed and put into effect have very substantially improved roll life. The tons per

roll change have also shown a decided improvement. We feel we have not completely solved this problem neither have we let up on exploring other ways and means to show greater improvement.

THE FIFTH PROBLEM

The final problem to be discussed is one concerning roll contours and their relation to problems of shape. This problem could be discussed quite extensively since we are faced with the problem of producing competitive materials from 22 to 90-in. wide; however, we intend to only briefly mention some of the difficulties relative to our 96-in. mill.

It might be well to mention at this time that the degree or amount of crowning to a roll varies widely, depending upon the individual installation and rolling practices. The purpose of a crown is to produce uniformly even and parallel pressure and contact of the work rolls with the backup rolls and the strip.

The problem confronting us was how to produce a product that would be acceptable to both hot and cold rolled processing as well as material for tin plate and galvanizing. We realized the rolling difficulties encountered when producing wide products, consequently, we established crowning practices that would be most suitable for these products. Because of this practice we created many finished shape problems for our narrow cold reduction mills.

The problem facing us had to do with build-up or ridge buckle, as it is commonly known. We are not inferring that roll contours such as we were using were solely responsible for this problem; however, through an exchange of information with other people in the steel industry, we believed that a change to the roll crowns, thereby changing the contour of the strip, would alleviate some of the cold reduction shape problems.

Our first approach was to change the existing crowns. In order not to affect the shape on the wide products, we believed it would be necessary to establish two different sets of crowning practices. One to be used on products up to and including 48-in. wide, and the other for products beyond this width. This change definitely indicated that we were on the right track, however, it presented quite a problem for our roll shop and operating people to have the proper rolls available for the different widths. In order to maintain this system, it would mean considerably more rolls in service, and considerably more storage area than was presently available. Rather than continue with this, we saw the need of developing one set of crowning practices suitable for all widths. This required an extensive series of trials with various changes in contours, in order to produce competitive products suitable to further processing.

Finally, it developed that one set of crowning practices could be satisfactorily used with our type of mill for the various type of products. However, we are not implying that our narrow cold mill and tin mill are absolutely free of ridge buckle problems; we are still receiving some complaints in this respect but they have been of a minor nature. In the cold mill, in order to definitely establish this one practice, it was necessary to make changes to the roll crowns, on the wide reduction mills, to compensate for the change in shape as delivered from the hot mill. Upon making these changes, they were still able to produce a product comparable to that which was produced prior to the changes being made in the hot mill.

At this time we would like to emphasize that problems, such as we have discussed here today, may or may not be common to other mills; however, we definitely know that numerous trials and studies must be made in order to find a practical solution.

In conclusion, we have endeavored to present in our paper, some hot mill problems relative to our 96-in. mill, along with some of our solutions. These ever-existing problems of industry present a challenge to us all—they not only stimulate interest in our work, but our minds are constantly alert for ways and means of correcting these problematic conditions. It requires effort and practical ability to meet these obstacles. We must constantly strive to go over the top or as said, "It requires no effort at all to roll down the hill but it does require an effort to climb to the summit." It is our sincere hope that these comments may prove beneficial in helping others solve some of their problems.

Discussion

PRESENTED BY

R. P. SCHULER, Manager, North Mills, Inland Steel Company, Indiana Harbor Works, East Chicago, Ind.

A. D. PATTON, Assistant to General Foreman, 96-In. Hot Mill, Pittsburgh Works Div., Jones & Laughlin Steel Corp., Pittsburgh, Pa.

R. P. Schuler: We definitely need more papers and discussion on the everyday problems of operating a hot strip mill. Every hot strip mill operator has experienced one or more of the growing pains the authors discussed.

The authors mention at the outset of their paper that the mill was expanded to produce various products which were not intended in the original design. One of these products mentioned was stainless steel. I wonder if Mr. Smith or Mr. Patton would like to elaborate on the changes they were required to make, so as to prepare their mill for the rolling of stainless steel.

They mentioned that in the beginning they increased the slab thickness to a point where they could no longer heat their slabs efficiently. Some operators claim a 7½ in. slab is the heaviest that can be heated efficiently, others say it is thicker than this. Did you arrive at an optimum slab thickness, if so, what was it?

Your problem on contour could very well be a paper of lengthy discussion in itself. Every hot mill and cold mill man in the industry would like to have you go into more detail on roll and strip contour, especially the people who are connected with the production of tin plate, who have had ridges, or build-up, as it is sometimes called.

Do you reduce build-up or ridge buckle by controlling strip contour? If so, what cross-section of strip produces the no-ridge tin plate, and how do you know when to make a correction, and what to correct? And then, when you have the proper shape, how do you hold the mill so that it produces this ideal section all the time?

We produce most of our tin plate on a 44-in. mill, I know that any time you get banded rolls in the first few stands of the finishing train, you naturally will get a build-up, or ridge, in the cold mill, but we have run into

ridge on material half an hour after a general roll change when all rolls were clean.

Just how do you control your contour, and when can you decide to change rolls, and what rolls do you change if all your mill is in good shape?

You mentioned, and I agree with you, that if you have a hot mill band which has a proper contour, that is, a normal crown which results from a smooth curve from the edges to the center of the sheet without any projections or sharp deviation, the cold reduced band will not have any ridges. Now the problem I would like to have discussed is how is this ideal contour achieved and how is it maintained and controlled during the rolling of the mill.

We have found in some instances that on a contour check we would have a high spot approximately 3-in. from the edge. In order to correct this the roller will change the last two finishing stands and on the next contour check immediately following the roll change the high spot has disappeared. Within a short time interval, say ten slabs, the high spot will reappear in the same location. Since the last two stands are practically new, the roller will proceed to change stands further back in the train. This is a time consuming procedure which results in a considerable loss of tonnage. Is there any way that you know of whereby the particular set of rolls which is causing the ridges can be picked out and changed immediately? We have run into ridges shortly after a general roll change, that is, after changing of all six finishing stands. I do not think our ridge problem at Inland is any different than at any other mill. We know the contour of hot mill band will produce the ridge-free tin. But the problem is how can you produce this contour and hold it for extended periods of rolling time after it has once been attained. You state that when you have improper contour you contact the roller and he makes changes. What changes does he make and why does he make them?

A. D. Patton: The first question had to do with stainless steel, and whether or not we made any changes in our equipment, or what was done in order to roll stainless. Actually, it was not necessary to make any extensive changes to our existing equipment. We did, however, remove the castings between the table rolls on the run-out table and also replaced numerous fire cracked rolls in order to eliminate scratches on the bottom side of the stainless strip.

Our experience with stainless steel was somewhat limited. During a period of construction when Allegheny-Ludlum was installing a new mill, we converted slabs into hot rolled coils in a limited number of grades and in fairly heavy hot band gages. The experience we acquired through this conversion deal, along with the exchange of ideas and rolling practices with many of you people in the industry, we have developed to a point where we feel well able to produce a competitive product. Incidentally, we have rolled down to 12 gage and as wide as 50 in. in many of the 300 and 400 series.

The next question had to do with the average slab thickness, whether or not we arrived at an optimum thickness.

We have increased our slab thickness up to 6 in. These 6 in. slabs became a furnace bottle-neck because as mentioned in our paper we have only three slab furnaces. As for others going to 7½ to 9 in. slabs, it would certainly be necessary to have 4 or even 5 furnaces and also would either require a 11-stand mill or a reversing rougher mill to make the lighter gages.

It might be well to point out that we were unable to order slabs heavier than 6 in. because the delay table between the roughing mills and the first finisher are approximately 100 ft in length.

As previously mentioned we felt these 6 in. slabs were not uniformly heated and our quality was being sacrificed. We feel that 5 to 5½ in. slabs are being uniformly heated and successfully rolled on our mill.

Regarding the next question concerning roll and strip contour, we agree that this subject could very well be a paper in itself, however, we discussed this problem very briefly in our paper hoping that it may lead to a full length lecture at some future meeting. I would like, however, to quote from a report that Mr. Smith once made when we were in serious trouble on ridges, or ridge buckle.

"A satisfactory solution to our ridge problem at Aliquippa has been effected by rolling our hot bands to a heavier crown than we were previously doing. Numerous studies at Aliquippa indicated that ridges would occur when cold reducing hot bands showing relatively no crown, or showing a hollow or wedge shaped gage contour. By measuring gage contours, we have been able to predict ridge tendencies in the hot band. Many figures have been recorded to substantiate this. Trial rollings with increased crowns through roll contour changes have been reported very successful in eliminating ridges.

We are attempting to produce strip with a minimum crown of 0.002 in., measuring the gage 3 in. from the edge of the strip to the center. We feel certain that the answer to Aliquippa's ridge problem is in the above practice and would also like to report a general improvement in the shape of narrow cold rolled sheet product as well as tin coils."

As a matter of information, our rejections for ridges some time back were as high as 5 per cent in other words, 5 per cent of the total product was rerolled for ridges. This year we are encountering less than 1 per cent rerolls for ridges.

The spacing of the ¼ in. V-jet nozzles is at present on 2-in. centers, evenly across the roll body.

The next question was whether we reduced build-up or ridge buckle by controlling strip contour. If so, what cross section of strip produces the no-ridge tin plate and how do you know when to make a correction and what to correct?

Yes, we very definitely reduce build-up or ridge buckle by controlling strip contours. As to what cross section of strip produces no ridge tin plate and what corrections have to be made, we can only say that our present crowning practices have proven most satisfactory and we see no need for any changes.

Your next question was what steps are taken when encountering improper contours on the strip?

The roller is immediately notified of this condition and he, first of all, makes absolutely sure that the mills are level. The next step would be to check the distribution of the water. If both of these items appear to be satisfactory, then it might be well to talk to the roll people and determine whether or not they are grinding the rolls properly. They may have some low spots on the rolls. We have found this condition in some cases. ▲

Modifications To The Fontana Open Hearth Precipitators

by Earl V. Akerlow, Division Manager—Steel
Kaiser Engineers Div. of Henry J. Kaiser Co., Oakland, Calif.

AN increasing amount of interest has been displayed by industry in the problem of air pollution control of the various industrial operations in this country. It seems to be a basic consideration that clean air is still one of the freedoms remaining, and to this end the metallurgical industries have been developing methods to control and police air pollution problems as they develop.

The Kaiser Steel Corp. plant is situated in an area that has long been highly conscious of its air pollution problem. The company has been engaged in a comprehensive study of this problem for many years.

San Bernardino County, in which the Kaiser Steel Corp. is located, is adjacent to Los Angeles County and has recently completed the formation of an Air Control District.

As a part of their continuing efforts in air pollution control, the problem of control for open hearth stacks was studied by the Kaiser Steel Corp. as early as 1943. Ten years ago the methods of developing accurate data on which to base collection and control equipment design were sketchy and indefinite. Further, the problem had not been studied regarding equipment design and selection, because no installations had been completed up to that time.

Since then the Air Control and Research Dept. of Kaiser Steel has prepared numerous studies and reports on cause and effect of various stack emissions discharged to the atmosphere. Kaiser Engineers co-ordinated design data with these studies to complement the research phase of the overall program. This provides an excellent development and engineering program and permits the co-ordination of research to engineering design of the various collection and control devices.

The nine 225-ton open hearth furnaces have received the major share of attention, as the metallurgical fume emitted is extremely fine and colored. Dry electrostatic precipitators are now operating or in process of construction on all furnaces.

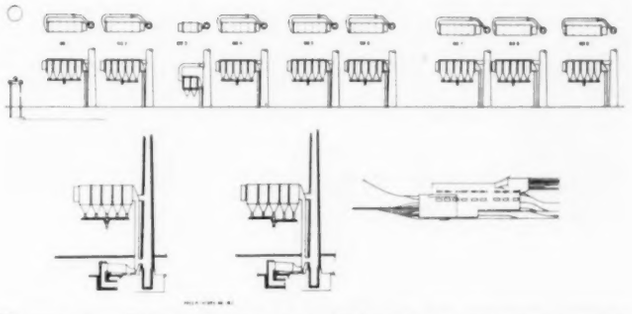


Figure 1 — Precipitators are designed to process, under normal conditions, about 74,500 standard cfm.

The proposed vessels for the oxygen converter process to be installed shortly at Fontana also will be equipped with dry precipitators.

This paper will deal with some of the problems of design and with the construction of and modifications to the precipitators as installed on No. 3 furnace. The installation of the precipitators at Fontana has its roots in No. 3 precipitator.

The precipitators are designed to process under normal conditions about 74,500 standard cfm at 650 F and 29.92 in. Hg., having an inlet grain loading of 0.53 gr per cu ft at 650 F. All precipitators follow waste heat boilers.

One of the interesting points of this installation is that it is possible to by-pass the waste heat boiler to the stack, or by-pass the precipitator to the stack, or to by-pass both units and go directly to the stack.

The problem of maintaining constant furnace pressure under varying stack loads was solved through the use of hydraulic control. No operating problems developed with the furnaces on which precipitators have been mounted.

. . . . electrostatic precipitators for open hearth furnace use should not be purchased on price alone . . . . rugged service requirements require attention to many details and features which will spell the difference between poor and good operation, maintenance and life . . . .

Early studies developed that the basic criteria as to gas volume and dust loading was correct. Early test data indicated that the erratic gas loading of the precipitator together with the varying characteristics of the fume must be carefully considered in the design of any future units.

Operating problems were carefully studied for approximately nine months. Pilot units were installed to determine why the prototype would not function as designed. These tests indicated that the following important operating problems required correction:

1. The vibration and shaking within the unit caused by movement of cranes, trains, and other heavy equipment in the open hearth building. This required strengthening and reinforcing of the precipitator and supporting structure.
2. The turbulent and erratic flow of gas entering the precipitator. Gas distribution was improved by modifications of design of the gas distributing devices within the precipitator proper.
3. Insufficient residence time of gas within the precipitator.
4. Low voltage and inadequate control of the connected energy to the discharge electrode system.
5. The sequence and type of rapping which permitted excessive dust build-up.
6. Automatic power control was needed to maintain voltage in the precipitator very close to the sparking potential during the varying conditions of the fume in the unit.

Each of these items may be considered as having a major bearing on the design of equipment for collection of the fume of the type encountered with a hot metal open hearth furnace.

Following the basic intent of conserving floor space wherever possible, and yet providing a trouble-free operating installation, the roof area of the open hearth shop adjacent to the stacks was selected as the best space for installation.

The original design of the open hearth buildings did not anticipate the installation of any equipment on the roof. The reasons for moving the unit off the charging floor were to avoid vibration within the unit, to isolate the installation, to provide more adequate servicing and maintenance, and also to obtain sufficient height for removing dust collected in the unit. The problem of mounting the precipitator on the open hearth roof became one of developing a design so the unit would not shake or vibrate with the passage or movement of

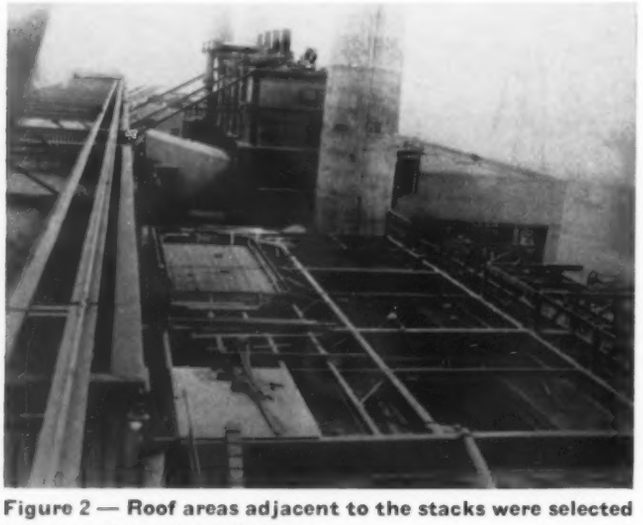


Figure 2 — Roof areas adjacent to the stacks were selected for precipitator installations.

Figure 3 — Precipitators are about 17 ft-8 in. wide, 59 ft-8 in. long and 43 ft-4 in. high installed.

Figure 4 — Structural steel supports of the precipitator were designed to be integral with the precipitator shell structure.

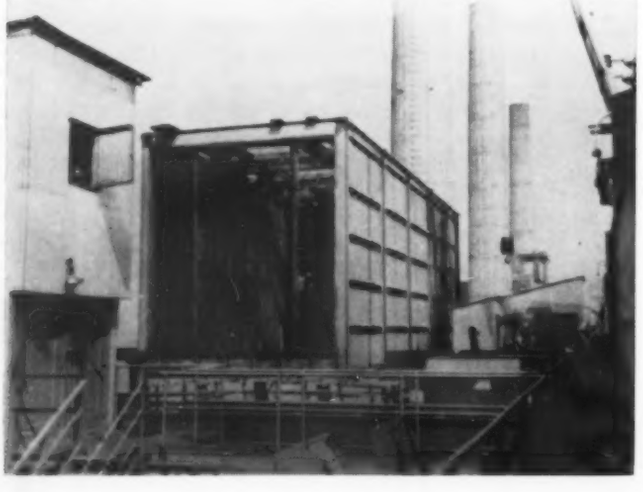
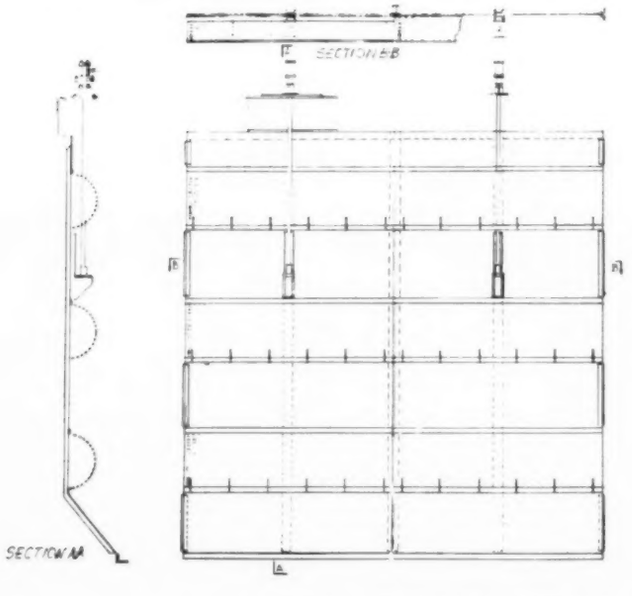


Figure 5 — Pattern of gas flow entering precipitator is an important factor in efficiency.



cranes, charging machines, or other equipment in the open hearth shop.

As installed, the precipitator resembles a rectangular duct with a width of 17 ft-8 in., an over-all length of 59 ft-8 in. from gas inlet to gas outlet, and a height from the dust outlet hopper to the top of the high voltage terminal housings of 43 ft-4 in.

It is designed to handle 58,500 cfm of dust-laden gases at 460 to 470 F and 29.92 in. Hg. The moisture content of the gases entering the precipitator ranges between 8 to 12 per cent H_2O by volume. The average inlet loading is 0.43 gr per cu ft at normal operating conditions. The pressure drop or draft loss permitted between the inlet and outlet is 0.5 in. of water. The structural steel support of the precipitator is designed to be integral with the precipitator shell structure.

Strengthening and reinforcing of the precipitator was necessary since it had been determined from previous tests and operating data that commercial precipitators, as presently manufactured, are too light in design for the extremely heavy duty required in open hearth service.

Precipitator reinforcing is important because vibration or movement within the precipitator must be kept to a minimum, since this vibration, or shaking of the discharge or collecting electrical sections, would cause arcing and shorting of the electrical system.

The discharge and collection electrode systems were strenghtened to resist the rapping cycles which are considerably heavier than currently practiced in conventional precipitator design.

Dust hoppers were provided with round corners, and the openings at the bottom of the hoppers were enlarged to permit freedom of movement of the dust. When square corners or shelves were found to cause dust build-up, they were removed by placing a round steeple over them.

In the early studies, we determined that the flow of gas entering the precipitator is very important as well as its distribution within the precipitator proper, for maintaining maximum efficiency at all times. This distribution section ahead of the electrostatic field was provided for the following three reasons:

1. To give the gas an opportunity to slow down and to reduce turbulence as much as possible.
2. To check out the heavy particles of material in the gas stream caused by blowing checkers or boiler tubes.
3. To provide space in the event it became necessary to add additional electrostatic fields to the precipitator for obtaining a higher collection efficiency than is possible with the present unit.

The entry of the gas into this first section was through a specially designed duct, with baffles placed in it in such a manner that it would reduce turbulence to a minimum, and cause the gas to flow over the entire area of the entering section of the precipitator. At the end of this section, and just ahead of the electrostatic field, a distribution plate was placed consisting of three curved, perforated baskets extending across the width of the precipitator. These baskets are mounted in such a manner as to provide uniform flow through the electrostatic field. This innovation was reached after several months of study with a water model and is one of the major contributions to this science. The design of gas distribution equipment within the precipitator proper also included baffles placed between the electrostatic fields and at the bottom of these fields. The baffles keep the gas from short-circuiting down into the hoppers and also maintain a relatively uniform flow through the grid work of the electrostatic fields.

At the outlet end of the precipitator, an additional flat, perforated plate was installed to keep the gas from short-circuiting to the outlet duct.

Several designs were studied in the outlet duct, but the one indicated on Figure 7 appears to be the most practical and is being improved in current installations.

From an operating point of view, there are advantages still to be gained if a little additional straight duct section could be added to the outlet.

To keep the distribution equipment clean, soot

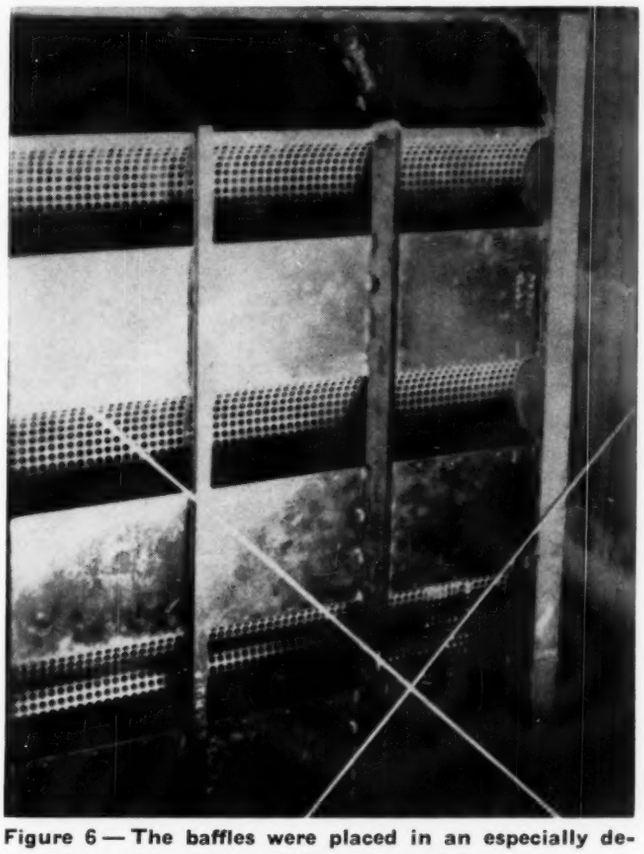
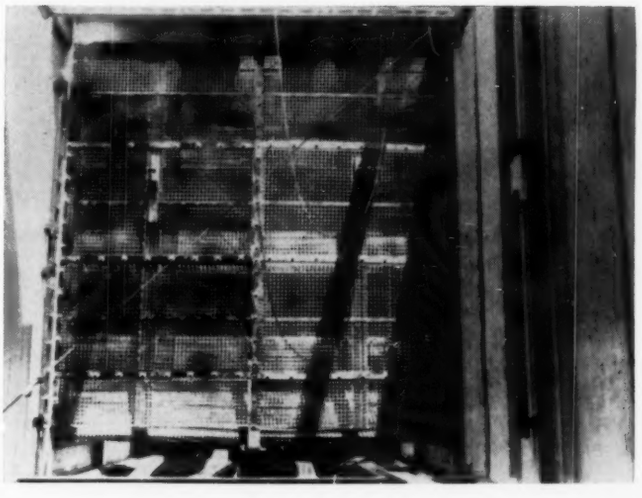


Figure 6 — The baffles were placed in an especially designed duct to reduce turbulence to a minimum.

Figure 7 — Additional flat perforated plates were installed at outlet end of precipitator.



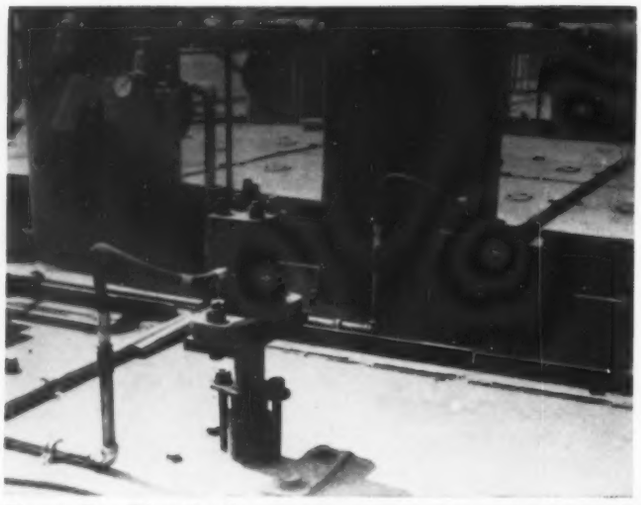


Figure 8 — Distribution systems were also equipped with rappers.

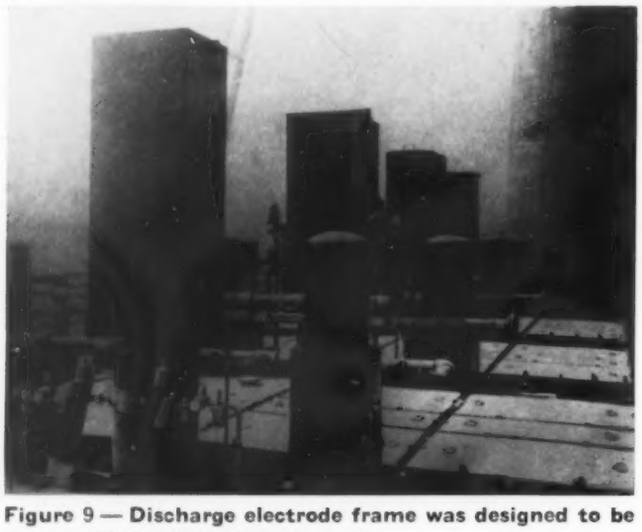


Figure 9 — Discharge electrode frame was designed to be one complete self-supporting unit.

Figure 10 — Control house for precipitator is of corrugated aluminum construction.

blowers were provided to clean the openings in the perforated baskets and to remove any dust build-up in the outlet duct. These distribution systems have also been equipped with rappers.

The residence time of the gas in the electrostatic field is related directly to distribution and over-all precipitator efficiency. It has been found that effective collection

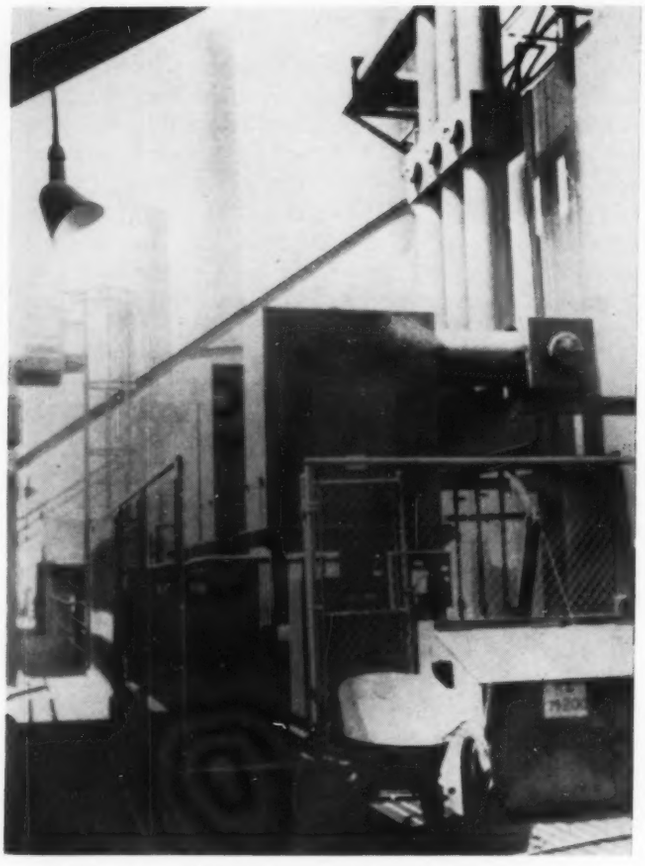


Figure 11 — Transformers are mounted on a tray.

at the temperatures indicated may be obtained with a gas flow of approximately two fps. Four to six fps is considered too high and re-entrainment of the collected dust at this velocity reduces the efficiency.

Conditions in the precipitator change rapidly, such as encountered during a lime boil when the fume changes from a metallurgical type to an alkali type. Also, during a hot metal charge, the concentration of metallurgical fume increases greatly.

Variable operating conditions of this magnitude and frequency present unusual precipitator power control problems.

Tests have been conducted with resistance control and monocyclic constant current network control in addition to the saturable reactor control installed on No. 9 precipitator. Although not fully conclusive, these tests indicate that saturable reactor control with added control circuit inductance is probably most satisfactory for this service.

Automatic feed back connections to maintain voltage near the "sparking" point in the precipitator will undoubtedly improve precipitator performance.

The No. 3 precipitator had the conventional mechanical rectifier equipment. No. 9 precipitator was designed to employ saturable reactor control with selenium rectifier transformers. While the first cost of selenium rectifiers is higher than that of mechanical rectifiers, it has inherent operating advantages. It maintains a higher root mean square voltage in the precipitator permitting improved precipitator operation.

The sequence and type of rapping is important for best precipitator performance. The unit was originally equipped for external rapping of the collecting curtains.

The rapping for the discharge electrode system was within the precipitator and was connected to the external air service through stainless steel tubing. The two systems were originally scheduled to operate automatically on one-hour thirty-minute intervals. We have learned that under certain conditions, the fume has a tendency to be sticky in nature, causing build-up on the discharge electrode frame work and on the collection frame work as well. Sometimes the dust, as collected, would sinter and no amount of rapping would remove it. In No. 9 precipitator, the discharge electrode frame was designed to be one complete self-supporting and rigid unit.

The rapping of this equipment was handled through outside rappers mounted on insulators which, in turn, are mounted in an air-cooled chamber. This has eliminated the problems of build-up, and keeps the precipitator relatively clean which will reduce corrosion and improve precipitator performance.

The collecting curtain system is similarly supported. The rapping cycles have been cut to 30 or 40 min, and when extremely dirty material has been charged to the furnace, it may be manually rapped from the operating floor of the open hearth. It is essential that the dust removal from collecting and discharge electrodes be accomplished as quickly as possible after it has built up and the time limits indicated appear to be the most effective. In connection with rapping, the low gas flow rate previously mentioned becomes important.

The rapping is a sharp, hard blow of substantial intensity and each blow is perhaps two seconds apart. This is a much better type of rapping for open hearth fume rather than a series of short frequency blows because the latter tends to pack the dust upon the collecting curtain.

A problem of condensation within the precipitator proper was corrected by the installation of light weight insulating aggregate concrete on the roof of the precipitator with a ferrule embedded around its perimeter. The insulation on the precipitator proper was a blanket-type material covered with an aluminum sheet properly flashed to the ferrule reglet on the roof perimeter. The hoppers, since they extend below the roof line, were not insulated, and the dust within them provides this insulation.

The control house for the precipitator is of corrugated aluminum construction provided with air cooling, and is as close to the precipitator unit as possible, to reduce line losses and corrosion of bus duct.

The inlet and outlet duct to the precipitator is equipped with expansion joints of the spun bronze type, otherwise the unit is as completely rigid as possible.

Installing the precipitator outside in this fashion also eliminates the installation of concrete control houses and transformer houses, since with an outdoor installation it is possible to use a tray on which the transformers may be mounted. All hatches in and around the precipitator proper have been designed for easy access.

The precipitators include automatic rapper controls and mechanical devices to reduce operating attention and maintenance to a minimum.

Also, remote meters are placed in open hearth control centers so that the precipitator operating conditions may be watched by operators without going to the precipitator control house.

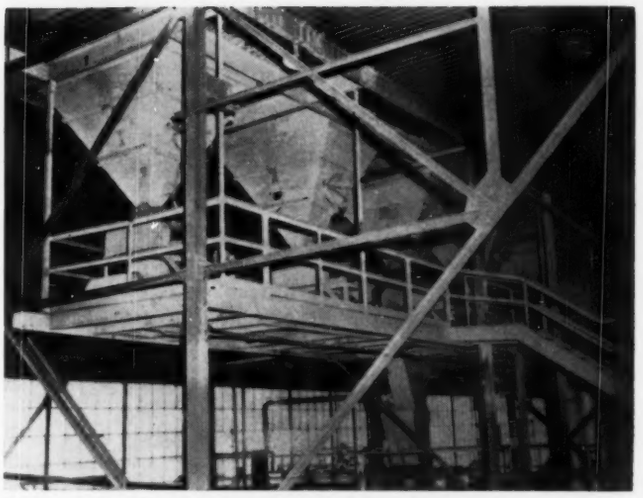


Figure 12 — Dust is removed through a motor-operated rotary feeder valve on each precipitator hopper which discharges to screw conveyors.

However, in order to maintain the precipitator at peak performance at all times, some preventative maintenance and operating attention is required.

Records of primary volts and amperes, and of secondary milliamperes provide a permanent log of precipitator operation. Records of this type are very important in comparing day to day operation and also long period operating trends.

The precipitator control house is located on the open hearth building roof, a location that is rather hot and dusty at times. Effective air ventilation and cooling system operation in the control house is very important to prevent deterioration of electrical control equipment, such as timers, relays and contractors.

Insulators on the precipitator, in the control house and in bus ducts may be broken or damaged by flashover if they have a coating of conductive or semi-conductive dust. A ventilating system for the precipitator insulator compartments is provided to protect the insulators. Periodic inspection and cleaning of all insulators is recommended to make certain that vent systems and housings are effective.

Rapping system components, including pneumatic rappers, solenoid valves, air cleaners and piping connections are inspected and adjusted at regular intervals. All of this equipment is located for easy access to facilitate inspection and maintenance.

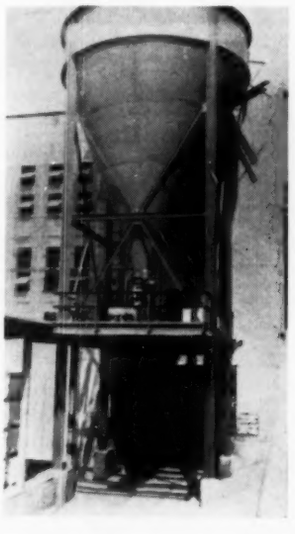


Figure 13 — Dust is pumped to a 25-ft diam storage bin.

Figure 14 — View shows stack with precipitator off.

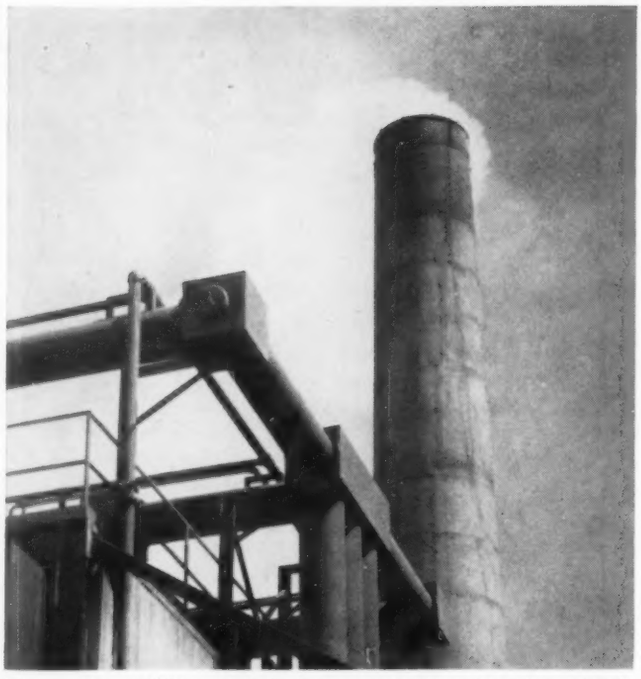


Figure 15 — With precipitator on, stack emits about 12 lb of dust per hr.

Electrode alinement is extremely important as one point of minimum electrical clearance in a precipitator will limit the maximum voltage that can be applied. Hence, electrode alignment and electrical clearances should be checked at intervals when furnaces are down for furnace or boiler repairs or maintenance. These checks, together with careful inspection of electrodes and supports should obviate any loss of time due to precipitator repairs or reduction in efficiency due to internal difficulties.

The dust removal system consists of motor operated rotary feeder valves on each precipitator hopper which discharge to screw conveyors.

The conveyors deliver the dust to a pump, and it is then pumped to a 25-ft diam storage bin located outside the open hearth shop building.

The collected dust flows freely when it is hot and aerated, but it is much more difficult to handle when cold and de-areated. Thus it is important that the dust is not stored in the precipitator hoppers for hours, but removed frequently in order to facilitate removal and handling.

After a unit has been installed, and prior to its acceptance, certain tests are required. The Kaiser Steel Corp. has developed methods and procedures as well as equipment that are now considered by the industry as an important step to more accurate results. It is possible that some of these will become accepted standards soon.

The final and most important check on precipitator performance is given by actual efficiency and stack emission tests at regular intervals. Operating and maintenance techniques developed by Kaiser Steel during the years since Precipitator No. 3 was installed, have reduced stack emission and boosted precipitator efficiency as compared to data obtained during acceptance tests conducted soon after installation was completed.

The precipitators at Fontana are now operating with an outlet grain loading in the neighborhood of 0.025 gr per cu ft, and actually emitting to the atmosphere between 6 and 11 lb of particulate matter per hr. The average amount of particulate matter entering the precipitator is about 160 lb per hr.

The stack (Figure 14), with the precipitator off, is emitting about 165 lb of dust per hr.

The same stack (Figure 15), with the precipitator on, is now emitting about 12 lb of dust per hr.

Some of the key points that have been outlined here in the design of open hearth No. 9 precipitator are being carried forward in the current installation of precipitators 4 and 5. The contribution made with this installation consists of basic data of value to the trade as a whole. The use of selenium rectifiers rather than mechanical rectifiers, special collecting and discharge electrodes; the special design and application of rapping mechanisms; and the development of gas distribution apparatus are among the most important.

Electrostatic precipitators for use on open hearth furnaces should not be purchased on price alone. Many of the hidden values indicated here are not on the average price tag, and will spell the difference between poor performance and good operation, low maintenance and long life.

Discussion

PRESENTED BY

WILLIAM W. RITER, Division Superintendent, Maintenance and Utilities, Columbia-Geneva Steel Div., United States Steel Corp., Provo, Utah

EARL V. AKERLOW, Division Manager—Steel, Kaiser Engineers, Div. of Henry J. Kaiser Co., Oakland, Calif.

William W. Riter: Mr. Akerlow, I would like to ask you three questions. No. 1, what type of a supervisory organization and maintenance organization do you figure will ultimately be required to operate and maintain the precipitators?

No. 2, is your problem of precipitation one of just

collecting all of the dust and dirt and gases that may come from the open hearth, or are you trying to collect some particular obnoxious gas?

No. 3, in relation to your rappers, do you have any particular maintenance problem with those rappers. And, if and when you do, do you have to take the precipitator off the line in order to make repairs?

Earl V. Akerlow: The supervision or maintenance of the precipitators involves a design problem. In working with this client we went into quite a long period of study to eliminate, if possible, operating personnel.

There is an organizational setup, but I do not know the exact definition of that organization. I believe, the operators of the waste heat boilers are required, at periodic intervals, to check the equipment.

The maintenance of the precipitators is handled by the maintenance group and the utilities superintendent has on call a pool of men, both mechanical and electrical groups, that are required to provide maintenance as requested.

Regarding the collection of dust, our first and foremost objective has been to collect all of particulate matter available.

As to obnoxious gas—we do not have what we call an "obnoxious" gas. We have the ordinary fume that you get with any hot metal open hearth furnace. There are no additives to the gas stream, such as steam or acid. So we are just interested in getting the particulate matter as such, and getting all of it that we can.

The reason that we overhauled the rapper design was to enable us to maintain them while operating. That was the reason for making each rapper independent and on its own system; to enable us to shut it off by itself, isolate it, take it out, put it in.

It cost us a little more money, but when you consider the added flexibility in keeping the precipitators operating, this detail becomes unimportant. They are as nearly free of maintenance as we can make them.

William W. Riter: Would you explain a little more fully the results that you get from your pugging mill operation on the reject dust?

Earl V. Akerlow: Yes, I will. The first time that we tried to pug the dust we found that it would plug, and it did plug because it is so fine and aerated. Then we added water to it, and we found when we added too much water we had a slurry. Well, we finally found a way to add just the right amount of water so we got a heavy paste.

Then we put this in railroad cars, only to find that the dust could not be removed from the car. The next thing we did, we tried a truck with an aluminum bottom—and that did not work. We finally found that if we took an ordinary dump truck—and take a sack of floor sweeping compound, throw it in the bottom of the truck, spread it evenly and put the load in there, then we can take it out and dispose of it.

To my knowledge that is the only way we have been able to work it out so far. We do not have a river in our backyard like some plants. What we are doing has worked nicely, however. ▲

Available Translations

As a service to readers of the Iron and Steel Engineer, a list of translations from foreign articles is being printed intermittently. Articles selected for this listing will be those thought to be of primary interest to the American steel plant operator. Those papers listed with a number only may be obtained from the Cooperative Translation Service, The Iron and Steel Institute, 4 Grosvenor Gardens, London, S.W. 1, England.

619 SEPTIER, et al.: "Improvement of the Output of a Basic Converter Steel Plant by using Large Bottom Converters," *Circ. Inform. Tech.*, 1956, No. 7, pp. 1415–1444.

543 DEHNE: "Removing Dust from Brown Converter Waste Gases," *Stahl u. Eisen*, 1957, No. 9, pp. 553–562.

620 BADING: "The Use of Oxygen in Refining Pig Iron," *Stahl u. Eisen*, 1957, July 11, pp. 926–931.

651 SCHULL and ROCHROHR: "The Basic Hot-blast Cupola as a Pre-melting Unit in the Open-hearth Steel Works," *Stahl u. Eisen*, 1956, Jan. 12, pp. 1–13.

533 KAZANTSEV and STRELETS: "Temperature Distribution in an Ingot during Heating in regenerative Soaking Pits," *Stal*, 1957, No. 4, pp. 358–361.

788 B SEDLACZEK: "Review of Iron and Steelmaking Practice: Part II—Rolling Mill Practice," *V. D. I. Zeitschrift*, 1955, Nov. 1, pp. 1121–1125.

724 PERLICK: "Automation in the Iron and Steel Industry," *Neue Hutte*, 1957, Feb./Mar., pp. 92–102.

648 BOGDANDY and SCHMOLKE: "Production of Finest Ore Agglomerates and their Behaviour in the Blast Furnace," *Stahl u. Eisen*, 1957, May 30, pp. 685–692.

649 BRANDES and WENDEBORN: "Sinter Cooling: An Essential Element of Modern Plant," *Stahl u. Eisen*, 1957, May 30, pp. 693–700.

+ 665 WEILANDT, et al.: "Dust Removal in a Strand Sintering Plant," *Stahl u. Eisen*, 1957, Aug. 8, pp. 1064–1069.

737 NASE: "Dust Removal in a Pallet Sintering Plant," *Stahl u. Eisen*, 1957, Aug. 8, pp. 1070–1074.

554 SPETZLER: "An Assessment of Various Furnace Linings," *Stahl u. Eisen*, 1956, Dec. 27, pp. 1734–1740.

790 RYABIN'KY: "Development of the Iron and Steel Industry in the U.S.S.R. during 40 years of Soviet Power," *Stal*, 1957, Nov., pp. 961–964.

550 GLALUNOV: "Changing Charging Gear of Blast-furnaces at the Novo Tagil Plant in Russia in Two Days," *Stal*, 1956, No. 12, p. 1134.

833 NEKRASOV: "Soviet Blast-furnace Production," *Stal*, 1957, Nov., pp. 965–968.

783 SCHILCHER: "The Evaporative Cooling of Blast-furnace Tuyeres," *Stahl u. Eisen*, 1956, No. 19, pp. 1229–1231.

862 NECHAEV: "Gas Turbines as Direct Sources of Blast-furnace Blast," *Stal*, 1957, Dec., pp. 1140–1141.

by Myron R. Bowerman
Director of Research
and Elvin R. Madison
Research Engineer
Alliance Machine Co.
Alliance, Ohio

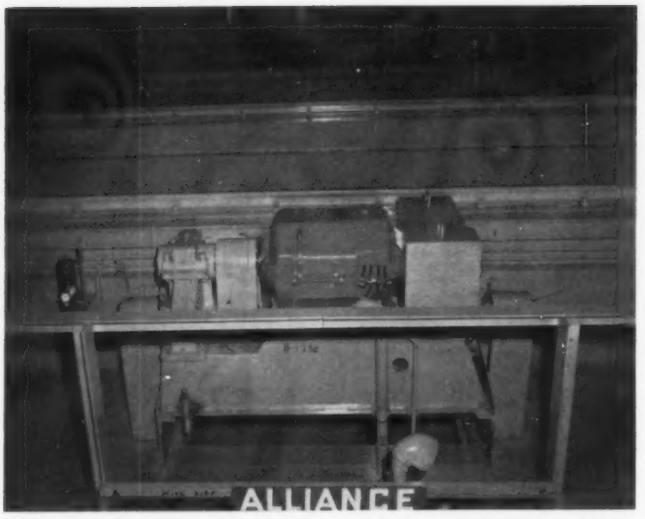


Figure 1 — Center reduction can take standard mill motors and either hydraulic foot brake or shunt.

Standardized Component Parts for Heavy Duty

Standardization of component parts will help produce a tried and proven crane in shorter time and at less cost . . . . this paper discusses some ingenious ideas which will enable the crane user to obtain crane equipment with some standardized components and which, at the same time, allows flexibility for load and service requirements.

HEAVY duty steel mill cranes have been difficult to standardize. However, in recent years, our company has made considerable progress in this direction. When the research department was organized, nearly four years ago, the company president, directed that standardization be a main item of the department's program. Some progress, had already been made in this direction and our chief engineer, has followed the work closely and has directed its application to estimates and engineered cranes.

When corresponding parts of several cranes can be made not only similar, but duplicate, fewer spares are required. Such parts can be identified and replaced more readily. They can also be procured more quickly from the supplier, and at less cost. Our redesigned component parts comply with AISE specifications as to material strength, and in most cases factors of safety and bearing life will exceed requirements.

We first considered bridge drives.

These may usually be alike regardless of whether the crane is a ladle, soaking pit, stripper, or general purpose crane. The AISE A-5 is our basic drive, although some of the component parts may be used in A-2 or other types. See AISE standard No. 6, "AISE" Specifications for Electric Overhead Traveling Cranes for Steel Mill Service."

The main units are center gear reduction and motor support, end gear reducers, and wheel and axle bearing assemblies. Other parts are lineshaft with pillow blocks, connecting shaft and couplings between end gear reducers and track wheel, axles, end trucks, end carriages and saddle brackets.

Track wheel bearings and drive gearing are designed to maximum wheel load and speed in a series of ranges into which our wheel loadings are grouped. For instance, our 60–80 drive handles wheel loads from 60 to 80,000 lb. Track wheel and bearing assembly will cover sizes of wheels used in this range and provide for the three types of bearings most commonly used, i.e., self-alining, tapered roller, and enclosed bronze bushings.

Maximum end clearance is provided using minimum space outside of wheel while maintaining proper bearing mounting. Each bearing box in its range has the same outside mounting dimensions so that all trucks or end carriages in that range are alike.

Safety factors in shafts, keys, couplings, etc., and allowable tooth loads in gears, are based on maximum wheel loads and speed and maximum slipping torque from these maximum wheel loads.

The gears are 20-degree full depth, heat-treated, and bearings in reducers are anti-friction, self-alining.

Bearing lubrication in gear reducers is with grease or oil, and gears run in oil.

Each gear reducer housing is of welded construction and made with fixed gear centers, but with clearance to provide for maximum variation of gear reduction so

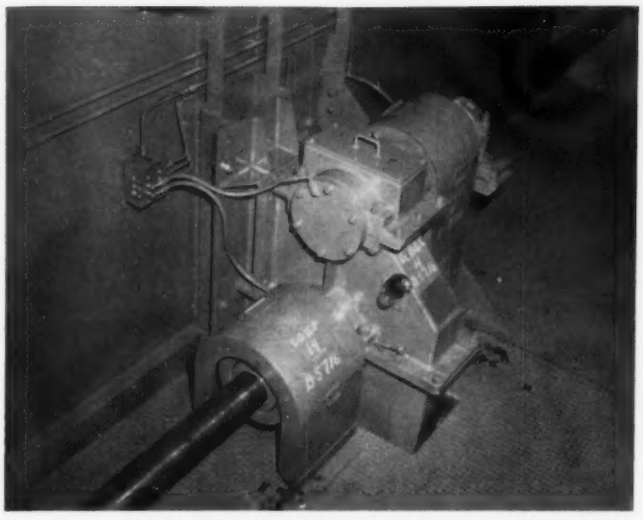


Figure 2 — Gear reduction may also be located at the end of the crane.

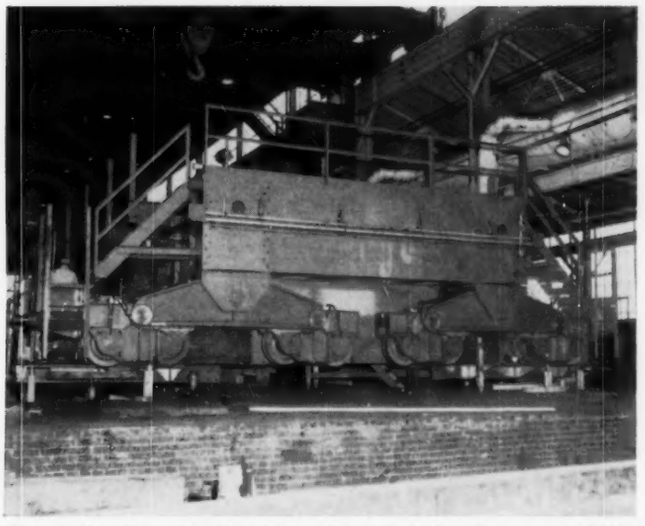


Figure 3 — Standardized wheel and axle bearing assemblies are used in this 16-wheel crane.

Mill Type Cranes

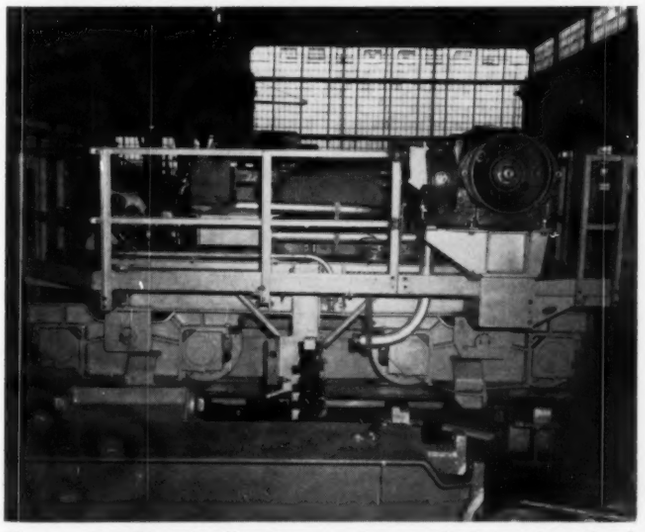


Figure 4 — Standardization is also applied to the wheel axle and bearing assemblies on the trolley.

that any desirable speed may be provided by varying the number of teeth in gears and corresponding pinions which are detailed with blank dimensions for pitch and outside diameters.

The center reduction unit and motor support is made to take standardized AISE 600 series motors and either hydraulic foot brake or shunt brake. Figure 1 shows a center reduction unit with motor support. Figure 2 shows an end gear reduction unit. Figure 3 shows a crane with standardized wheel and axle bearing assemblies in double compensating trucks.

TROLLEY DRIVE

In trolley design we consider first the travel mechanism since the same, or similar, drive may apply to many trolleys of similar weight and speed requirements, but whose hoist and other motions may vary greatly. So in this mechanism we have established ranges of wheel loadings and have developed assemblies of track wheels, axle and bearings and gear reducers to fit the requirements of wheel loadings and speeds, somewhat similar to the bridge drive.

In several cases, we have built cranes using for the trolley exactly the same wheel, axle and bearing assemblies as were used on the bridge having twice the number of wheels. Figure 4 shows an 8-wheel trolley with standardized wheel, axle and bearing assemblies in place. Figure 5 shows one corner of the 16-wheel bridge with the same wheel, axle and bearing assemblies as were used on the 8-wheel trolley. A line of trolley drives has been developed using a single outboard bearing at each track wheel and a rigid through shaft, of size to take the bending stress. The gear reducer is carried on the axle with a torque arm attached to the trolley frame.

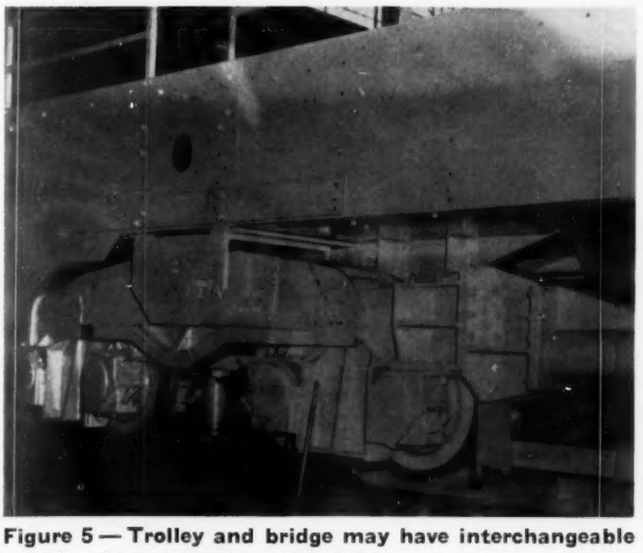


Figure 5 — Trolley and bridge may have interchangeable wheel, axle and bearing assemblies.

Figure 6 shows the single outboard bearing design with the reducer mounted on the axle. This single bearing design allows a more simple frame construction which is less expensive. If preferred, the gear reducer may be bolted to the trolley frame. In some trolleys of this type,

the hoist equalizer bracket is supported from the idler axle.

In the same ranges we also have the common construction of track wheel supported between two bearings, as is shown on Figure 7.

HOIST ASSEMBLY STANDARDIZATION

Some mill cranes, such as ladle cranes, have special hoists which are not considered here. However, many heavy duty cranes have standard trolleys. Also, a stripper or pit crane often has a standard auxiliary hoist. The auxiliary trolley of a ladle crane whose hoists are commonly designed with extra factors of safety may well use a standardized hoist derated proportionately.

The development of standardized component parts for hoists is more difficult than for travel mechanisms. The variables are hoist capacity, speed, gear reduction, drum diameter, and rope reductions. The authors approached this by first dividing the hoists into ranges,

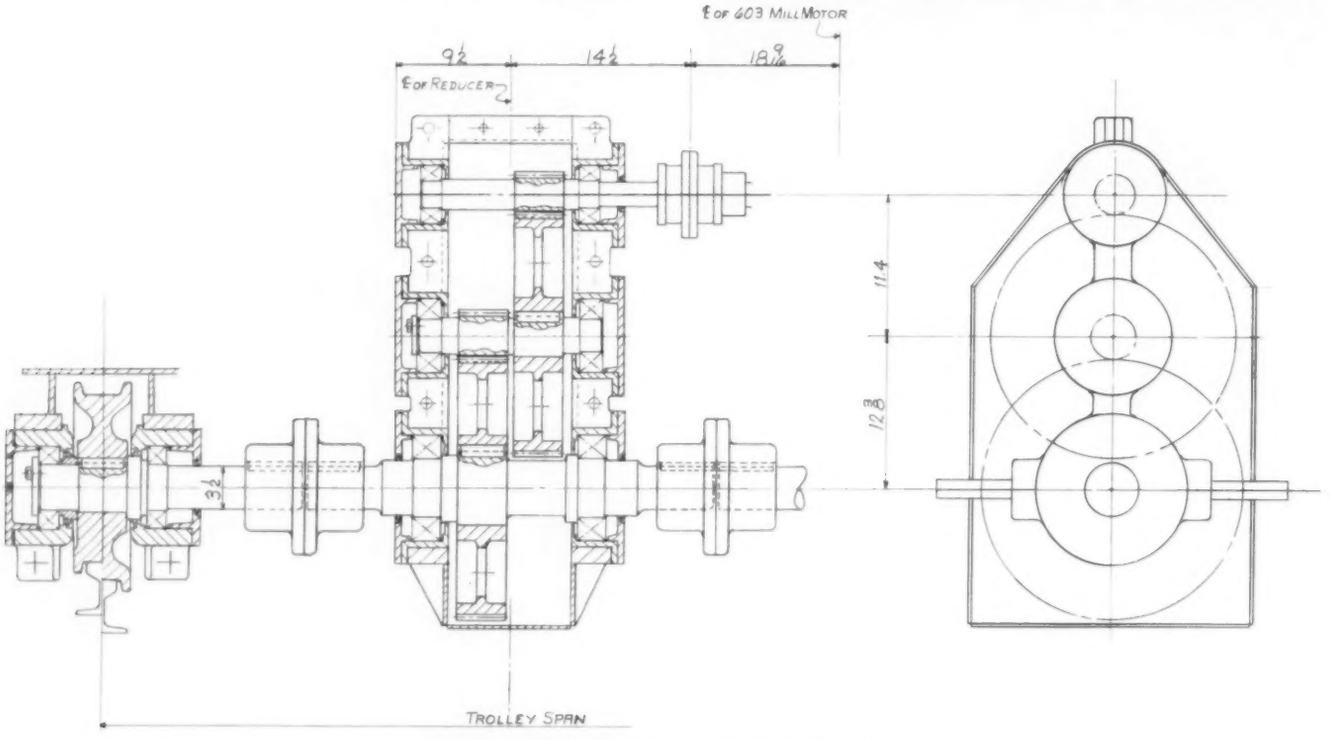
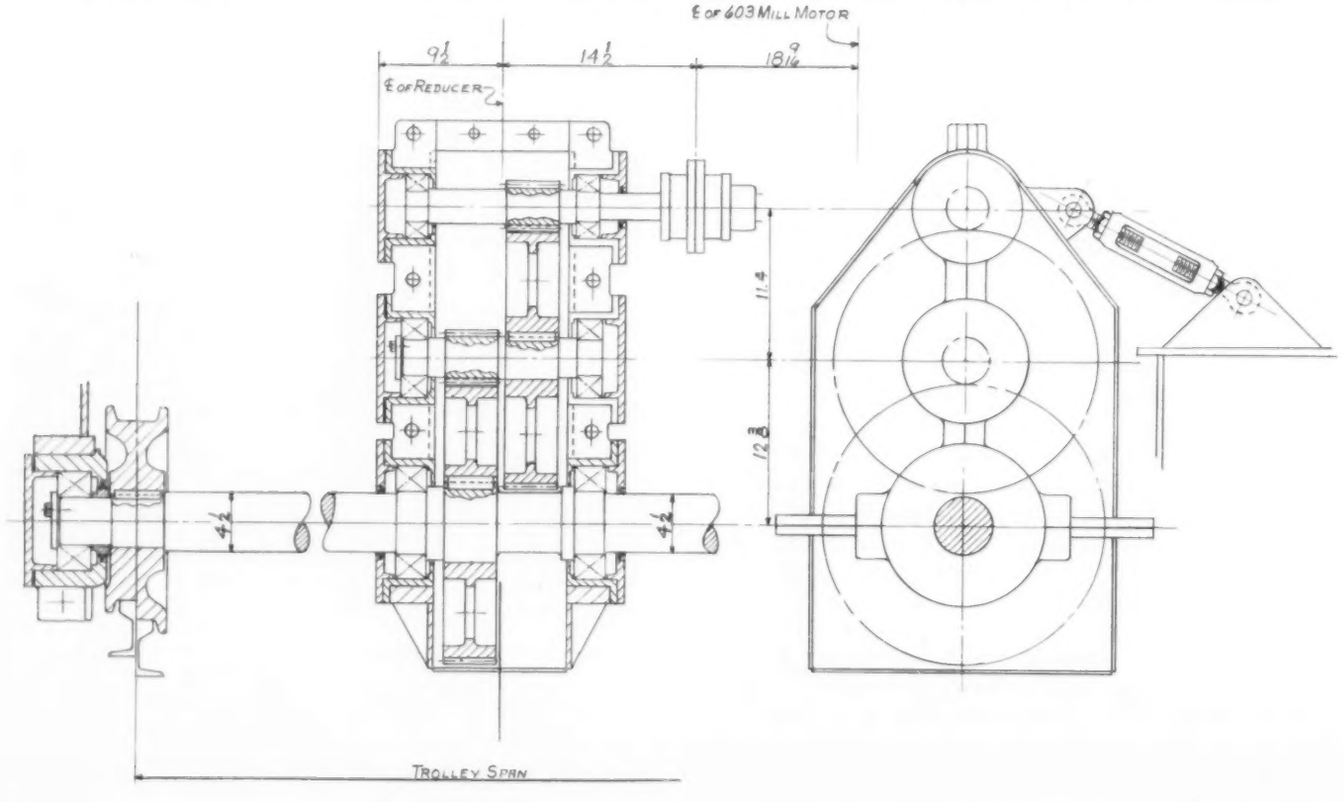


Figure 6 — Reducer is mounted on the axle.

Figure 7 — Standardization also includes common construction of track wheel supported between two bearings.



based on hoist capacity. Each range was then analyzed and divided into two sub-divisions covering the two rope reductions used. Then calculations were made for each capacity and each rope reduction involved, to determine the motor horsepower and required gear ratios for speeds varying from very slow to high speed. These calculations were then graphically plotted with hoist speed in feet per minute against reducer gear ratio, and where each section of the various curves is for a specific rope reduction, capacity and horsepower.

The hoist speeds were then divided into five classes from slow to high speed.

Each section of the graph is therefore, divided as to speed, class and number of ropes, and each curve within the section is for a specific capacity and hoist motor horsepower.

Figure 8 is the graph which covers the lowest range considered, which is the 10, 15, 20-ton hoist capacity. The "X" axis shows the hoist speed in fpm. This has been sub-divided into five speed classes. The "Y" axis shows the total reducer gear ratio.

There are two groups of curves, the upper being for hoists using a four-part block and the lower is for hoists which use an eight-part block.

For example, a 15-ton hoist is required at 50 fpm. This would be a class 3 hoist as it is between 40 and 50 fpm. In the upper group of curves, note the curve labeled 415–65 hp. This indicates four-part block, 15-ton capacity with a 65-hp mill motor. Hence, at 50 fpm the required gear ratio would be 29 to 1. This reducer carries the catalog number 3415.

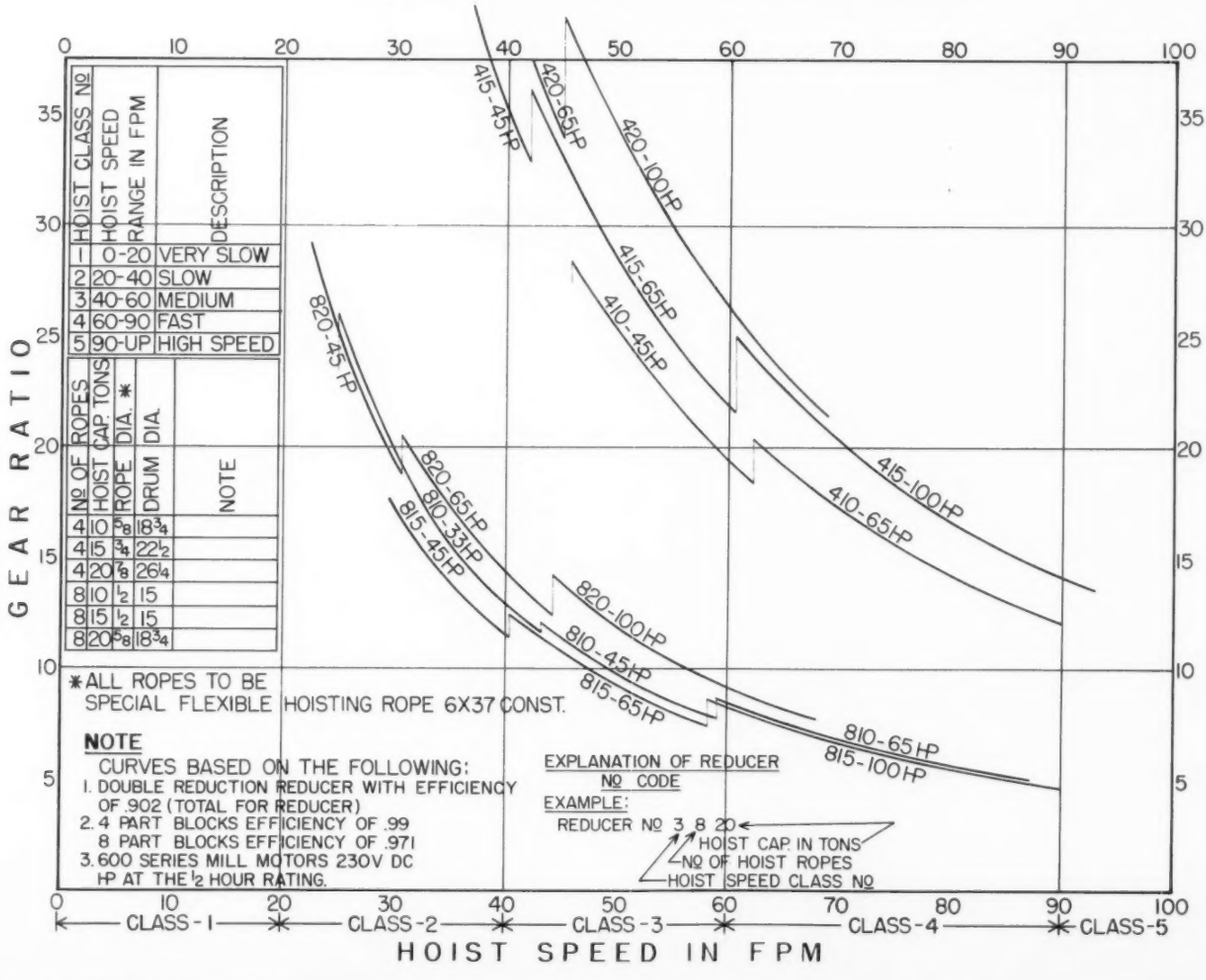
If so desired, the same hoist can be supplied with an eight-part block. Note the curve in the lower set of curves marked 815-65 hp. At 50 fpm the required gear ratio is 9.5 to 1. This reducer carries the catalog number 3815.

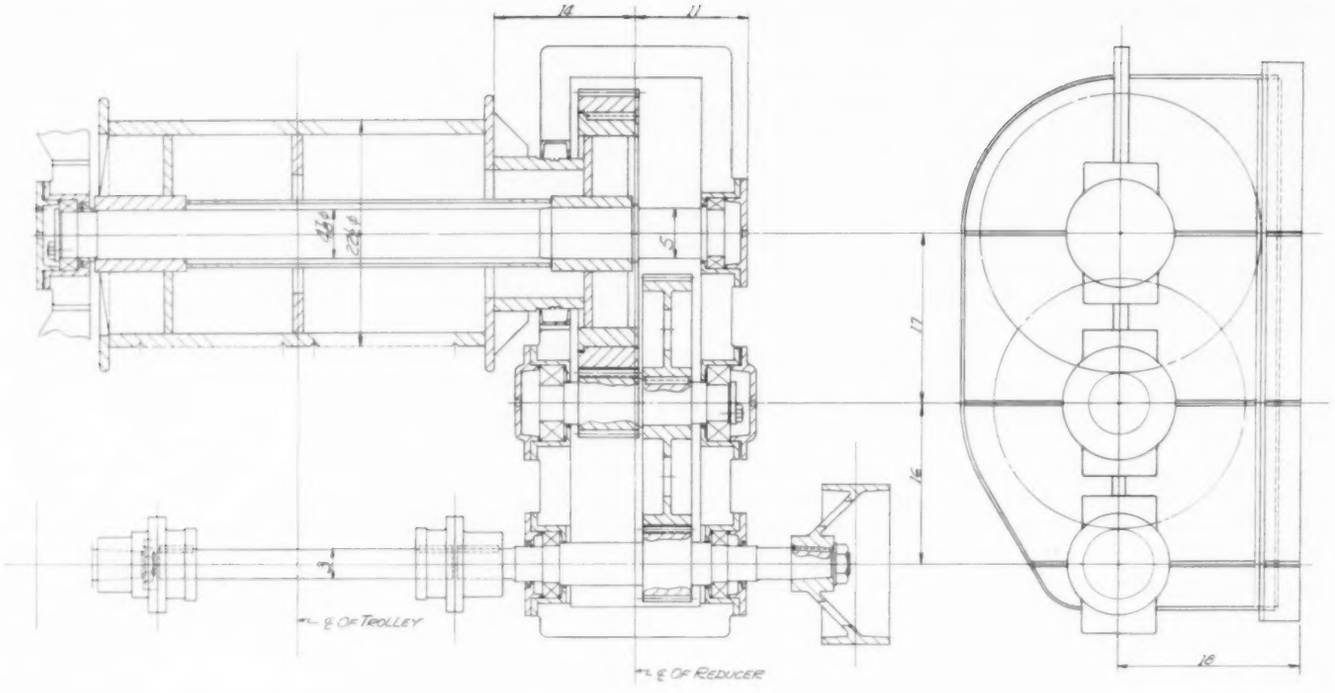
Using this analysis, hoist reducers were *designed* and *catalogued* to *cover the various divisions within each range.* The gear reduction units are of rugged design, meet AISE specifications, and, in most cases, exceed them. The bearings are anti-friction and mounted in capsule housings. The first reduction is herringbone and the second reduction is either spur or helical. The reducer case is a weldment, designed to be bolted to the trolley frame. This simplifies the trolley frame.

The reducers are designed for two types of drums. One is the old style where the drum is bored and fitted with a shaft pressed in place. The neck of the drum is then fitted with a ring gear, pressed on and keyed, as is shown in Figure 9.

The second type is a design where the drum shaft is an integral part of the welded drum, as is shown in

Figure 8 — Design chart has been set up to cover selection of standard hoist.



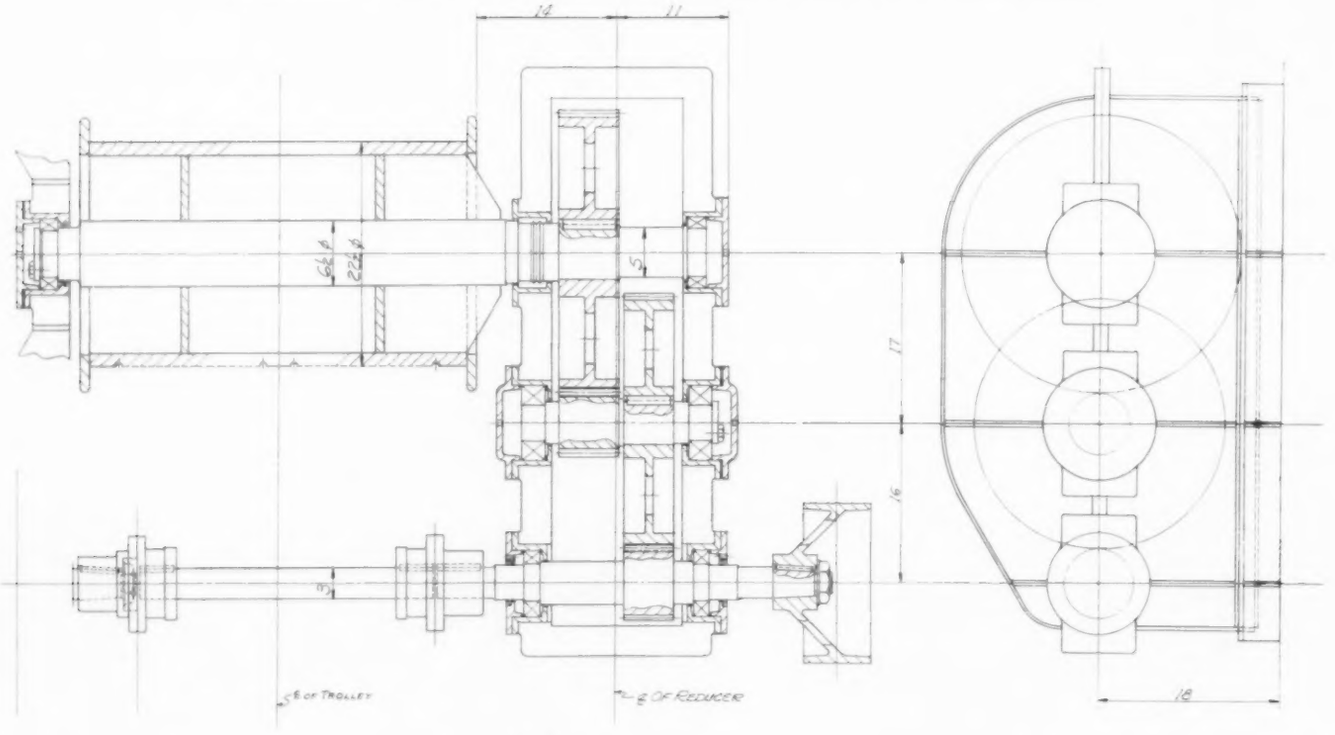


"B" DESIGN

Structural drum with neck where-on drum gear is pressed in place and keyed.
Drum shaft pressed in hubs in drum.

Figure 9 — In this design drum is pressed in place and keyed.

Figure 10 — In this design drum shaft is an integral part of the drum weldment.



"A" DESIGN

Structural drum with drum shaft as an integral part of the drum weldment.
Reducer housing designed for right or left hand assembly etc.

Figure 10. The end of the drum on which the drive gear is mounted is of ample size for the bending stress. This design permits the use of a rugged welded drum which is less expensive. The reducer case is symmetrical, allowing right or left hand assembly, and provides variation in size for different ratios.

The advantage of standardization of component parts of heavy duty mill type cranes is considerable. It is beneficial to both the customer and the crane builder. Most important, the customer receives equipment that has been well designed and proven. It is equal to and, in most cases, better than called for by AISE specifications. Also, delivery can be improved inasmuch as much designing and detailing has been done. This means that gearing, bearings and other outside material may be ordered earlier.

Duplication of sub-assemblies for various cranes in a customer's plant can be extensive. This will result in a saving in both investment and storage space by greatly reducing the spare parts inventory. A group of five cranes recently installed in one plant varied from a 40-ton crane with single bridge drive and end carriage as shown on Figure 11, to a 50-ton crane of 120-ft span with double drive and trucks as shown on Figure 12.

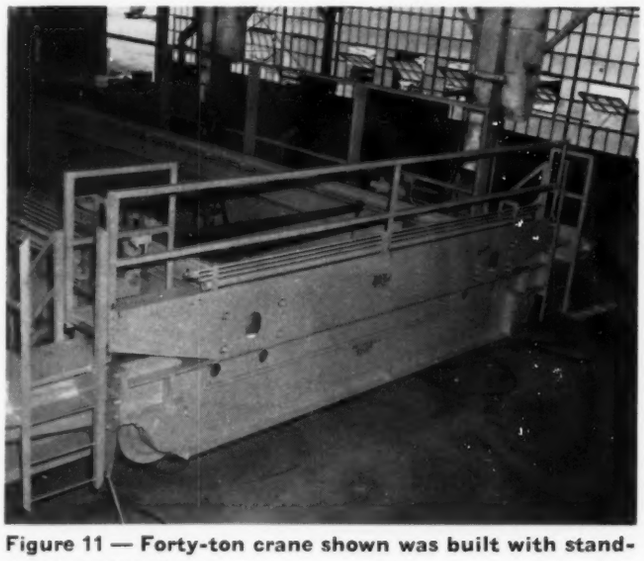
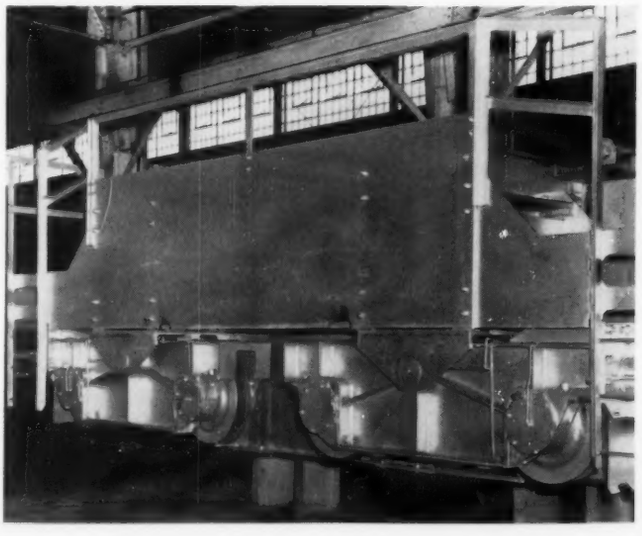


Figure 11 — Forty-ton crane shown was built with standard components.

Figure 12 — This 50-ton crane of 120-ft span with double drive and trucks uses some of the same sub-assemblies as that shown in Figure 11.



Each crane in this group used the same sub-assemblies, resulting in duplication of 56 wheel-bearing boxes, as shown in Figure 13; eight trucks, as shown in Figure 14; 14 end gear reducers, as shown in Figure 15, and seven center reducers with motor bases as shown in Figure

Figure 13 — It was possible to duplicate 56 wheel-bearing boxes.

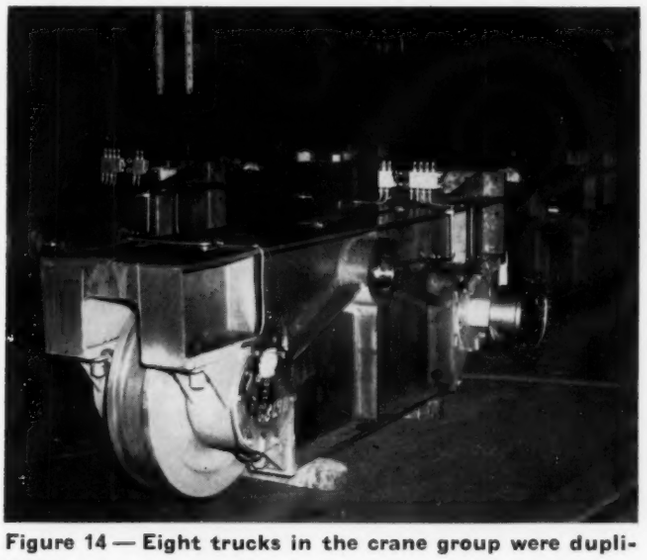


Figure 14 — Eight trucks in the crane group were duplicates.

Figure 15 — Some 14 end gear reducers in the crane group were duplicates.

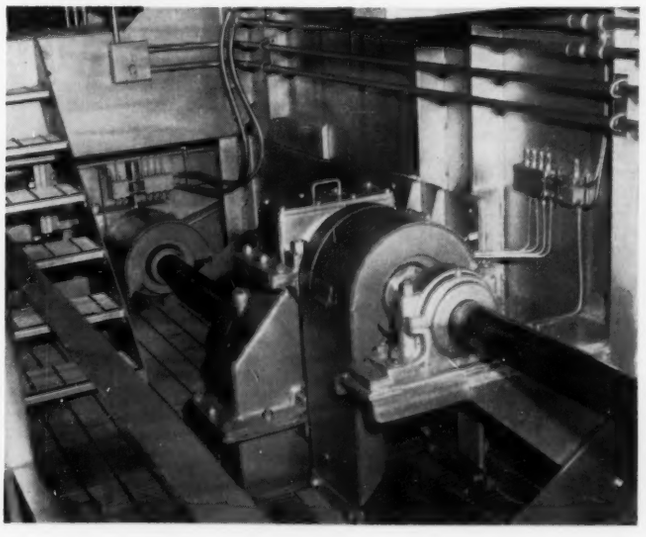


Figure 16 — Some seven center reducers in the crane group were duplicates.

16. Fewer spares are needed, and as new cranes are added, further duplication may result.

This program enables the crane builder to control the cost of manufacturing more effectively, and improve delivery. A considerable saving of time is effected in engineering since estimating, design, layout work and checking are simplified and much of the detailing completed. Duplication of parts results in more efficient machining, making possible the use of templates or jigs. Certain parts may be stocked for future use. A saving is also made in the structural shop which fabricates the gear reducer housings, trucks, end carriages, saddle brackets, etc.

Standardized component parts and sub-assemblies will help produce a well designed crane in a shorter time and at less cost.

Discussion

PRESENTED BY

F. R. FIELDING, Chief Engineer, Republic Steel Corp., Buffalo, N. Y.

E. L. ANDERSON, Superintendent Electrical Dept., Bethlehem Steel Co., Johnstown, Pa.

IRWIN ROSENAK, Chief Engineer, Inland Steel Co., Indiana Harbor Works, East Chicago, Ind.

M. R. BOWERMAN, Director of Research, Alliance Machine Co., Alliance, Ohio

F. R. Fielding: We are accustomed to technical papers and discussions relating to crane maintenance and crane runways and have found them very helpful. The subject of this paper dealing with standardized design is very interesting and new to most of us and we think was placed in very capable hands. We might ask ourselves the question why it has taken us so long to go to work on the problem. It is a fact that most of our cranes have been custom built to fit a specific physical condition and type of operation without special planning for fast replacement of component parts.

Much of the old equipment of early expansion periods is being replaced today, and new plants are being constructed and it is a good time to study, develop and present a standardization program. Can we expect that the other major crane builders will also be developing a similar program and perhaps even exchange ideas for a more extended standardization?

I have a few questions I would like to ask: Would you review the main characteristics of the basic bridge drives A-5 and A-2? What relative crane capacity in tons compares with 60 to 80,000 lb wheel load rating? Would cranes in any wheel load class have a uniform trolley spread and bridge wheel base? Why is not the 20 degree long and short addendum tooth used as standard since it is figured to be stronger and more quiet? (See article by John J. Stolz in *Iron and Steel Engineer* October, 1956.) Will standard gear reducer housings provide for differences in the width of a tooth face? How does standardization provide for the various bridge girder lengths and end connections? Are worm gear drives for trolley travel and for hoist to be recommended? Is any thought being given to eliminating the conventional drum gear and pinion and substituting an enclosed reduction unit?

E. L. Anderson: I would like to compliment Mr. Bowerman and Mr. Madison on a well prepared and delivered paper. I want to pose two questions to the authors.

1. On the trolley drive gear reducer which was vertically arranged, what provision is made for lubricating the gearing and bearings during periods that the trolley might be rocked back and forth and wherein the gears would not make complete revolutions to carry the oil throughout the entire assembly? Is a pump used in connection with this gear reducer and if so is it separately driven by a small d-c motor?

2. On the interchangeable parts such as gear reducer units, trolley and bridge track assembly, bearing housing, etc., are these jig machined so that a complete unit may be interchanged? This service is essential for a standardized design so that completely assembled spares may be carried in stock. On some cranes, even though they were so called duplicate parts the present manufacturing practices are not always interchangeable.

Irwin Rosenak: We are looking for ways of getting better equipment, faster deliveries, and with lower costs. If standardization of crane components can do that, we are for it.

One of our problems in the application of a new crane to a new building is the problem of clearance between the running rail and the building column. With standardization of this dimension, you can allow building design to go ahead before definite decisions have been made on cranes and be sure that the crane will fit when ordered. If this standardized design will also allow use of either self-alining, tapered roller, or bronze bushing for track wheels, you then have greater flexibility in crane selection.

Duplication of spare parts would be of considerable savings in the reduction of the number of spares which must be kept on hand. If many cranes in the same department can use the same components, such as track wheel assemblies, gear reductions, hoist drums, this would make quite a savings. Some of these items, such as hoist drums, are infrequently needed and are expensive. The possibility of interchangeable parts on trolley

drives and bridge drives would help decrease the number of spares.

Considering the many years of experience the crane builders have, you would think that you would never come up against any new problems; however, occasionally specifications for a new crane will entail a new combination of weight, span, speed and capacity which requires new engineering on the part of the crane builder. In some cases, the new design may become troublesome and require changes in certain components before the troubles are finally ironed out. If the crane builders can achieve standardization so that all the various components would all be of design previously used and field tested, then one could be sure that every crane could go into service without difficulty.

Inland Steel Co. has long recognized the benefits of crane standardization. We have had our own set of electrical and mechanical crane specifications for many years. Copies of these specifications, which consist of about 125 pages, are in the hands of manufacturers of cranes and of electrical and mechanical crane component parts. We have found it very beneficial to standardize on such items as collector staffs, collector bars, brackets and collector shoes. We have nearly 300 cranes in our Indiana Harbor Works, and these components are standard on practically all of these cranes.

M. R. Bowerman: Answering Mr. Fielding's comments in order: On relation of crane capacity to bridge wheel load range, there can be no linear relation since the wheel load varies with bridge and trolley spans and number of wheels used, as well as variation of capacity.

Trolley span and bridge wheel base will vary with bridge span. In one group, we had a 15-ton crane of 90-ft span and four bridge wheels with 60,000-lb load, also a 120-ton crane with short span and eight bridge wheels with 72,000-lb wheel load. Both cranes are in the same range for component parts. One crane is single drive, the other double.

On long and short addendum for gear teeth, this system has certain advantages and can be furnished if desired. Replacements may not be as quickly available.

Gear housings allow for some increase in gear face, at least one half inch.

Girder proportions and end ties are made to AISE specifications.

On worm drives for trolley motion and hoists, worm gears are very well adapted to hoists. They are not so well suited to trolley motions particularly because of reversing and impact.

The question also comes up why A-5 drive is used rather than A-3. We do build many more of the A-5 arrangements and recommend it as being good design and accessible. In some cranes the A-3 with motor speed on the line shaft would cause trouble especially with a long span crane.

Bolted connections for hoist gear reducer are sometimes questioned. We find the separate construction more economical to build. If desired, connection to trolley frame may be welded as well as bolted.

In answer to Mr. Anderson's questions. In lubricating trolley drives, we find that most drives are properly lubricated with the drive gear running in oil and the bearings grease lubricated. For a special application as mentioned, we have used a motor driven pump to circulate oil to the motor pinion. This requires separate conductors when operator's cab is on the bridge.

Track wheel and bearing assemblies are interchangeable and connect to machined surfaces on carriages or trucks. The gear reducer assemblies are machined alike then lined up on trolley frames or girders and bolted to connection angles which angles are then welded to parent structure. Thereafter, a spare reduction unit will replace the original unit.

Referring to comments by Mr. Rosenak, the end clearance is a most important figure in both crane and building design. We would suggest the following minimum dimensions from center of runway rail to face of column to provide 3 to 5 in. of clearance.

Bridge wheel loads, lb	*Center of rail to column face, in.*
To 30,000	12
30,000 to 60,000	15
60,000 to 80,000	17
80,000 to 100,000	18
100,000 to 120,000	20

Mr. Rosenak states the situation perfectly in regard to the great variety of specifications and details of construction in steel mill cranes. Many plants, even in the same corporation, insist on special construction which has evolved from their operating and maintenance departments.

Standardized proven component assemblies can be delivered sooner, and cheaper and less total spares will be required. Motors, brakes, limit stops and control panels are now accepted as manufactured. Why not gear reduction units and wheel and axle assemblies. This still leaves choice of conductors, insulators, collector supports and pick-up shoes to suit customer standards.

We appreciate the various comments submitted. They give us a better picture of your requirements. Our purpose is to serve the industry. ▲

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SAFEGUARDING STEEL PRODUCTION

. . . . the wise steel plant operator will check and recheck on his fire protection methods and promptly arrange for the correction of any deficiencies that such a survey may disclose . . . .

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IT is ironic that this paper must necessarily deal with the steel industry's most useful medium, the very life-giving blood of steel production, as actually being that medium which is capable of stopping the production of steel.

This "Dr. Jekyll and Mr. Hyde" medium, capable of playing the double role of friend and foe alike, is the element of fire, as well as its co-partner in crime, that peril which is commonly termed "explosion."

Fire may be classified as either friendly or unfriendly. Under complete control it is probably the most indispensable servant of mankind, providing warmth as well as the tool by which Nature's raw products can be converted into commodities necessary to our way of life. Thus, fire in that role is truly man's best friend.

Having precisely the same properties, but progressing and increasing in magnitude beyond human control, or persisting to a lesser degree where fire is not supposed to exist and where its presence may result in human suffering, physical damage or disruption of production, it very definitely becomes unfriendly. In this role it can be man's worst enemy.

GENERAL APPROACH TO THE FIRE PERIL

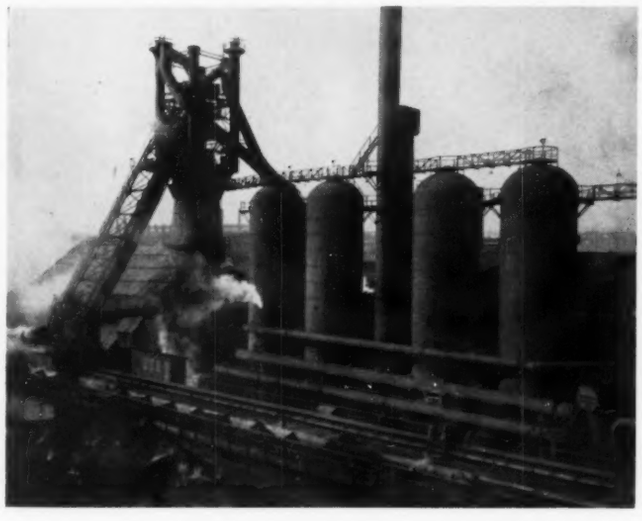
It is an established fact that 85 to 90 per cent of all unfriendly fires are comparatively small at their incep-

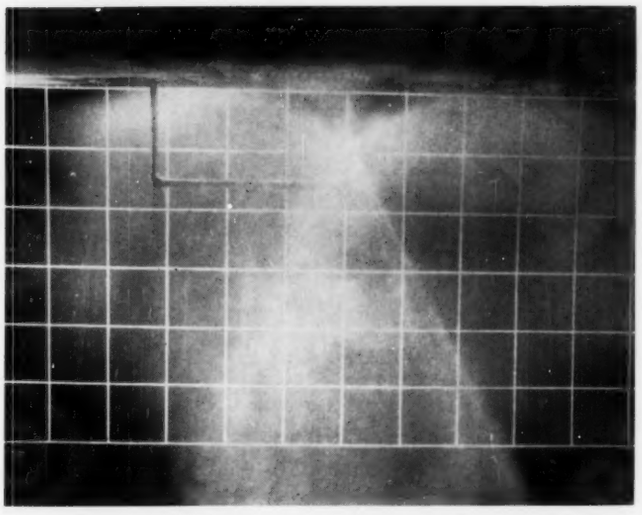
Figure 1 (left) — Steel is the life blood of American industry.

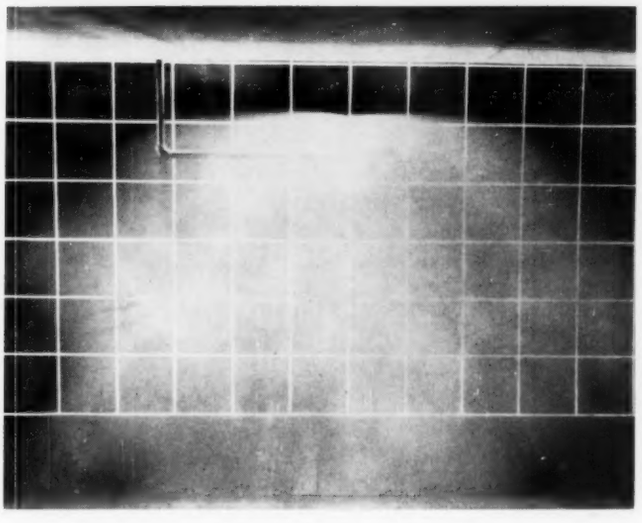
Figure 2 (below) — The blast furnace is a key factor in steel production.

Figure 3 (upper right) — Water discharge pattern of conventional sprinkler head is shown against background divided into square feet.

Figure 4 (lower right) — Water discharge pattern of spray type sprinkler head is shown against background divided into square feet.







tion. Thus, it follows that extinguishment or control of fire can be accomplished with comparative ease in its very early stages. From a practical standpoint, it is virtually impossible to have a bucket of water or a suitable extinguisher at the point of fire origin in time to accomplish this around the clock, day after day. For this reason, few are checked at their very inception, the majority rapidly gain in area and in intensity. At this point, fire must be stopped while still small by a suitable and sensitive combination fire detection and extinguishing system.

No system to date has yet proved itself so thoroughly capable of doing this very job, around the clock, day after day, as the automatic sprinkler system. In fact, records compiled by the National Fire Protection Association covering a period of over two-thirds of a century have established that automatic sprinklers are 96.2 per cent efficient in detecting, controlling and extinguishing fires in sprinklered properties. Of the 3.8 per cent remaining, failure to do the complete job when fire strikes has been traced to the human element, neglect, poor maintenance, inadequate water supplies, obstructed waterflow and distribution and factors that actually do not originate within the system itself, but external thereto. Thus, sprinklers are virtually 98 per cent efficient, a record that remains unchallenged.

The automatic sprinkler is the very basis of protection against fire and has universally been accepted by industry for the safeguarding of property which fire may attack. Expressed another way, the automatic sprinkler works every minute out of every hour, every day in the year, to safeguard production, the investment of stockholders, the income of employees and the resources of industry.

Necessary to such unparalleled performance is a supply of water, which, in volume and pressure, is capable of maintaining effective sprinkler system operation for a period of time that will outlast and finally subdue the worst probable fire in a property. There should remain a reasonable reserve that will assure complete extinguishment should reignition occur before the consumed portion of the water supply has been restored.

When a fire is initiated by a flashover, as in an area laden with a hazardous gas, explosive vapor or combustible dust, or where such flame propagation may take the form of an explosion, also where the human element results in the prematurely shutting off of sprinklers, the water supply may be seriously overtaxed. Extinguishment and control can then be brought about only by other methods, including the use of hose streams. At this point, the private fire department and the public fire services must be relied upon to bring about final extinguishment. Let there be no misunderstanding, however, that because the fire services are mentioned

Figure 5 — Burning hydraulic oil from ruptured piping brought down this naked steel in 15 min.

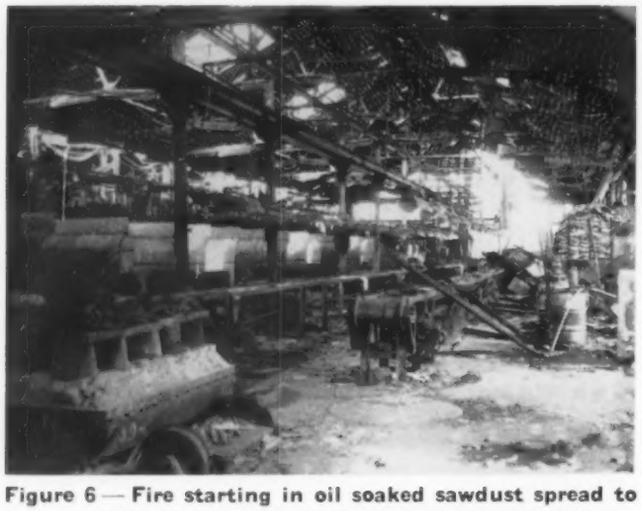


Figure 6 — Fire starting in oil soaked sawdust spread to spray booth, then to asphalt-asbestos coated metal structure. Entire roof of 455-ft structure was involved within 20 min. from start of fire.

last, by no means should they be called upon only as a last resort. That procedure is almost certain to bring about disaster. Quite on the contrary, the fire services should be summoned first and then a fire attacked with suitable fire-fighting equipment that is at hand.

Thus evolves the conventional manner in which industry meets the fire and explosion peril. There follows a procedure which might well guide the steel industry in meeting these perils wherin they are found to exist. At the outset it is recognized that the steel industry, by nature, is not exposed to the same relative degree of fire peril that many other industries are, such as woodworkers, rubber plants, paint factories, chemical works and terminal grain elevators. However, there are, inherent to the steel industry, certain severe well-defined fire and explosion hazards and these will be discussed in their proper place.

SELECTING A SUITABLE PLANT SITE

Since transportation of iron ore and limestone is generally more easily available by water than by other means, most steel mills locate along the shores of inland lakes or along the banks of inland waterways and thus have available virtually inexhaustible sources of fresh water from which to meet all present and future demands for service and fire protection. In this respect, such steel mills are more fortunate compared to those inland plants served by near-by strip mines, where water front is not essential.

With the ever diminishing ground water supply and progressive lowering of the ground water table, combined with sustained droughts, obtaining water that does not flow or accumulate upon the earth's surface is becoming a real problem. In fact, safeguarding our subsurface water supply should be, if it already has not been so considered, a problem for national concern.

Therefore, make doubly certain that a proposed plant site has ample water. The volume and pressure requirements are related to the combustibility of structures, to their relative size and fire areas, to their height above grade, to the degree of fire exposure external to such structures, to the degree of hazard arising from occupancy exposure from within the building and to the concentration of values to be protected, both in property and production.

Efforts have been made to develop a workable set of rules by which one may select a combination of water supplies amply and adequately engineered for all conditions, but so far such efforts have failed to produce any easily workable formula or guide table. The fire protection and service water demands for any given plant must be carefully studied for each property taking the above factors into consideration, also with an eye to the future, and facilities provided on that basis.

In general, however, it can be said that a system pressure of less than 100 psi does not provide for adequate fire service. Hose streams taken from hydrants at a lesser pressure generally do not have either the range or output to do an adequate fire control job. Similarly, taking into consideration the average height of buildings found at a steel mill that are likely to be equipped with fixed automatic protection, either sprinklers, water spray or foam, efficiency suffers unless water can reach the structure, at roof level and in the volume required, at close to 75 psi pressure.

It might be of interest to mention that both from the viewpoint of necessity as well as economy, designing a structure to collect and conserve rainwater as a means of augmenting other sources of supply is not unusual. By piping rainwater runoff from large area buildings to a reservoir, it is easy to collect 100,000 gal or more from a modest rainfall.

SELECTING SUITABLE CONSTRUCTION MATERIAL

It is needless to state that from the standpoint of fire protection, construction materials should be fire-resistive or noncombustible. The use of any other material capable of sustaining combustion only serves to increase the cost of fire protection facilities if a plant is to be fully protected against fire.

The use of reinforced concrete as well as protected (fireproofed) steel provides maximum structural resistance to fire. Considering the economic life of such buildings, their strength and stability in resisting wear and tear from occupancy and from the element, this type of construction in the long run may be a justifiable choice. Wherever reinforced concrete or protected steel can be used, consideration to its use should be given.

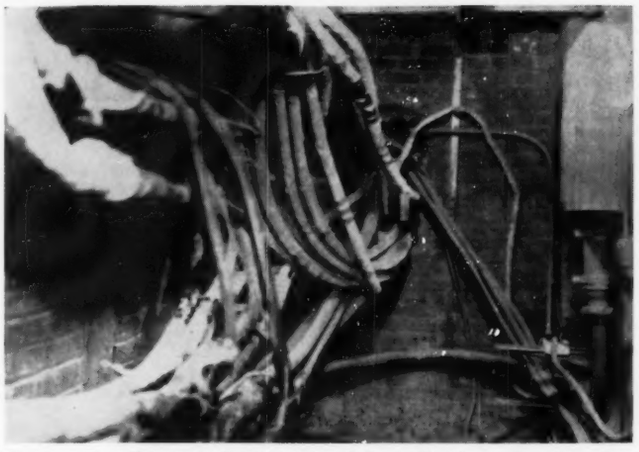


Figure 7 — Disorderly electrical installations invite production interruptions.

Figure 8 — Clean motor rooms leave little for fire to feed upon. Large rotating units should have automatic carbon dioxide flooding.

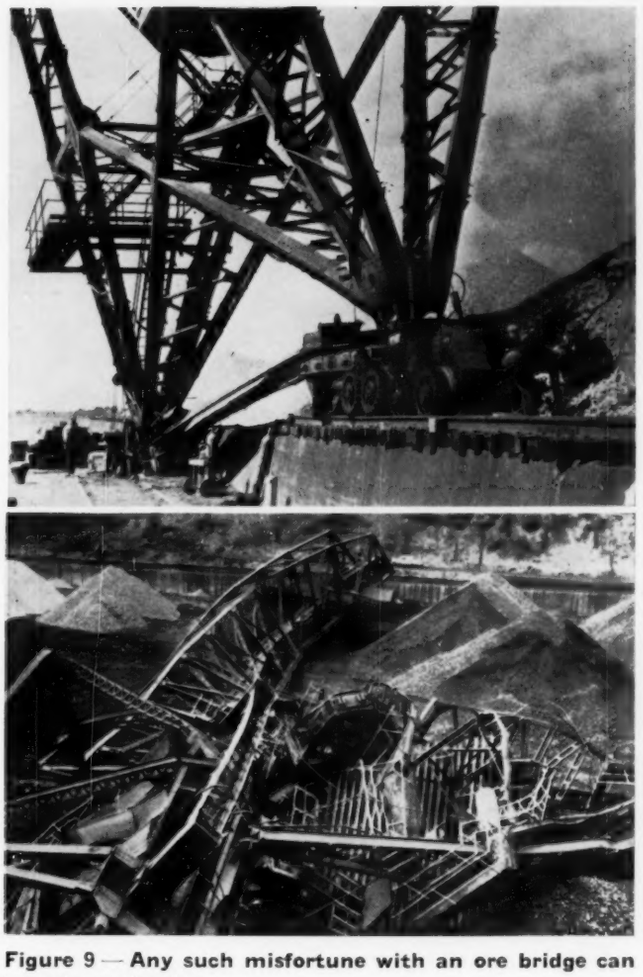


Figure 9 — Any such misfortune with an ore bridge can impair production.

In the steel industry the magnitude of operations is such that neither type of construction is usually practical for most process areas. Further, since the normal steel mill fire hazards are not likely to develop into fast-spreading fires communicating over vast areas, neither type of construction can be justified from a fire protection standpoint alone. At this point it becomes imperative to qualify the foregoing by stating that there are many exceptions where this superior type of construction is vital to the safeguarding of production in the steel industry.

For example, areas where molten spills and overflowing ladles are inherent hazards must necessarily withstand substantially high temperatures over extensive periods. Fuel gases from defective or damaged piping also provide an ever present threat to the area from both a fire and explosion potential viewpoint.

Portions of the cast house exposed from within by the same molten metal spill potential should be capable of resisting substantially high temperatures without damage.

Portions of the rolling mills, specifically oil cellars, should be fire-resistive for obvious reasons. There is sufficient fuel in such areas to bring about serious structural damage if involved in fire, especially at a time when fixed fire extinguishing equipment is impaired.

At an integrated steel mill, in the by-products and benzol areas involved in the production and handling of flammables, the inherent fire and explosion hazards justify the use of construction materials that provide maximum resistance to these perils.

In safeguarding steel production, bottlenecks require the best safeguards that can be engineered and selecting good fire-resistive construction for housing these bottlenecks can be considered the first step. Power houses, transformer rooms and substations, compressor, blower, generator and all large motor rooms, including switchboard and switchgear areas and pump rooms are, to name but a few, locations where again the best of construction is justified. One might raise the question of justifying fire-resistive construction for these bottleneck areas based alone upon the fire hazard potential. There are other perils such as tornado and hurricane, yes, and even earthquake, which justify heavy construction if steel production is to be fully safeguarded. With the ever increasing amount of air traffic involving heavy commercial aircraft, as well as light privately owned and operated planes, the peril of falling aircraft is not to be passed over lightly. Far removed as one might view this particular hazard from the sky above, no single acre in our forty-eight states is wholly immune from this peril. If a manufacturing plant, steel or otherwise, is to completely safeguard its production, these bottlenecks should be provided with protection all the way, otherwise the chain is only as strong as its weakest link.

By far the most common type of construction used in

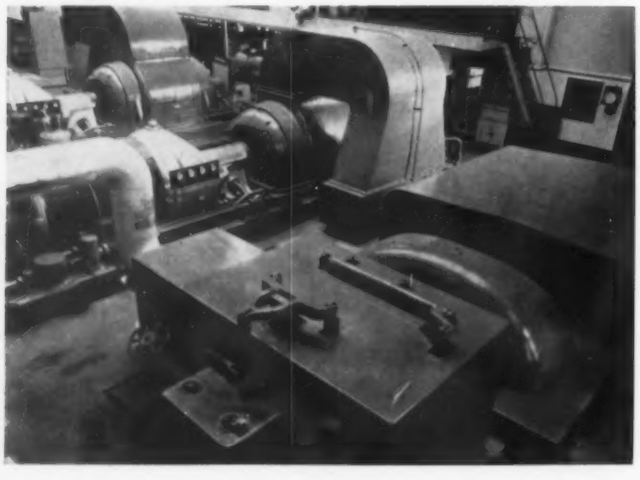
Figure 10 — Automatic water spray protects electrical power bottleneck.

the steel industry is that commonly called "noncombustible," involving a very wide variety of reasonably light skin materials secured to unprotected or naked steel. These skin materials may include corrugated, ribbed or other preformed metallic sheets, uncoated or coated, rigid or frangible sheets of cement-asbestos combinations, as well as any number of built-up panels, planks or slabs having exceedingly low flame spread ratings, according to standards of recognized fire testing laboratories. Roofs may also include poured or precast concrete or gypsum slabs or other mineral base materials, also supported on naked steel.

This is not the time and place to prompt a discussion of the physical properties of naked steel, but it is generally recognized by fire protection engineers that when fire exposure temperatures reach a zone of 800 to 1000 F, the unprotected steel is in jeopardy. In fact, before this temperature is reached, exposed steel in a severely restrained structure may begin to deform and distort to a point of no return, even though collapse is not initiated.

If such distortion weakens a structure and endangers those who work within, the replacement of damaged members or portions of the structure may prove to be as costly as though the apparent damage had been greater.

Figure 11 — Automatic carbon dioxide protects another power bottleneck.



Considering what fire did to a 35-acre manufacturing plant involving steel decking on structural steel framing, which was brought to the ground in ninety minutes, resulting in the largest single industrial fire loss in American history, one can argue as to the unqualified use of the word "noncombustible" as applying to naked steel construction.

Neither is this the time or place to prompt a discussion as to the conditions of exposure, from within or from without, that establishes the limit of noncombustibility of a given type of construction involving unprotected metals. In fact, this is controversial and rightly so, until the exact answer is developed from an appropriate and comprehensive test program.

While fire exposure tests have been run by various organizations inside and outside of the fire insurance industry, there are so many variables that a test involving interior fire exposure or fire loading in a comparatively small structure does not give the complete answer. The actual height of a building, its area, the amount and relative position of heat venting with respect to point of fire origin, the extent of steel in the structure both in ratio of surface to mass as well as the heat absorption characteristics of the occupancy, all have a relation to that amount of fire exposure which can bring about structural damage.

Asphalt coated corrugated metals have been used extensively by the steel industry as wall and roof covering materials. Some, although resisting the elements quite well, have been found to propagate fire rapidly over large areas. Manufacturers have improved the fire resistance of coated corrugated metals so that those listed by recognized fire testing laboratories as having a flame spread rating less than 50 (the flame spread rating of red oak being 100) are viewed as noncombustible from a building standards viewpoint. At plants having existing structures using older types of coated metals, not having such low flame spread characteristics, many are following a program of progressive replacement with improved types either on a building-to-building basis, a strip replacement basis or, where replacement is not economically justified, the installation of automatic sprinklers to confine a fire to its small area of origin.

It goes without saying that buildings of combustible construction, if of any size or importance, should be equipped with automatic sprinkler protection. It is somewhat common in the steel industry to find yard sheds and miscellaneous shops and service areas in unsprinklered combustible structures. A fire in such an area may not be of great consequence, or seriously affect production, but a bad fire developing might well produce a serious fire exposure to other nearby important structures and thereby be a source of production interruption.

SAFEGUARDING ELECTRICAL INSTALLATIONS

Probably no single factor is so essential to the maintaining of production continuity as that of an uninterrupted power supply. Inasmuch as the steel industry, by its very nature is so dependent on electric power, no system of safeguards can be too complete for the protection of the entire electrical installation.

From the public utility or power station to the rotating equipment and controls which keep the steel moving, all transmission lines, transformer stations, switch-

gear and rotating machinery should be protected from all potential perils. Not only do these include lightning (and serious surges), fire, explosion, wind and ice loading but also the possibility of mechanical damage.

For example, occasionally one may find outside stock handling equipment, such as ore bridges or gantry cranes operating dangerously close to important transmission line towers. Failure of braking facilities for such movable equipment can easily result in a collision with and serious structural damage to such transmission towers.

Transformer yards are vulnerable in that there exists in a relatively small area a comparatively heavy concentration of high-valued, all-important bottleneck equipment. Unless such transformers are of the Askarel type, a fire or explosion involving one transformer can readily involve other units close by thereby crippling extensive production facilities dependent thereon. Automatic fixed fine water-spray fire extinguishing equipment is recognized as providing an adequate safeguard against this peril.

Another example of vulnerability is found in the all-important mill motor rooms, where again high-valued bottleneck machines are concentrated. Not uncommon is the use of portions of such areas for the temporary or unauthorized storage of electrical equipment or emergency replacement parts in somewhat oil soaked wood crates or other types of combustible packaging. From the production interruption viewpoint, this can be most serious and very definitely the use of these electrical areas for combustible storage should be prohibited.

The safeguards normally provided for motor rooms should be of a type not likely to cause damage to the equipment; specifically, the use of carbon dioxide is considered preferable to water. Accordingly, it is current sound fire protection engineering practice to equip large rotating units with fixed carbon dioxide fire extinguishing equipment. In the event that a stubborn fire persists, once the unit is very definitely de-energized, the use of fine water spray is effective.

SAFEGUARDING FUEL SUPPLIES

Probably no other plant stores and consumes as much coal at a single location as a steel mill. Therefore, it is hardly in order—or even necessary—to discuss in this paper the safest manner in which to store and handle coal; rather, the author might well promote the storage practices of the steel industry in this respect. As operators of many coal mines, where else can better authorities on coal handling be found? However, for the sake of reference, certain important storage procedures are noteworthy.

Figure 12 — Compacting coal storage reduces spontaneous ignition tendencies.

New and existing storage areas should be initially cleared and kept cleared of other combustibles. A safe distance from all potential heat and ignition sources should be maintained. Coal should not be piled around or against combustible structures, including trestles. The movement of air through the pile should be prevented so far as possible, this by leveling and compacting the fuel. The periodic checking of interior temperatures by use of sealed (at the bottom) piping or thermometer wells will provide a running check so that any portion tending to heat can be used first before a critical spontaneous heating temperature is reached. Once ignition has occurred in a pile, the combustion process cannot be arrested without actual removal of the area of fuel that is being consumed. It is recognized that spontaneous heating tendencies are the greatest in "green coal" fresh from the mine as well as coal having a sulphur content in excess of 1 per cent.

Where the handling or processing of coal evolves the generation of coal dust, such measures should be taken that will minimize the dust explosion hazard potential. In handling great volumes of coal from a thoroughly practical viewpoint, dust cannot be avoided. It is practical, however, to avoid sources of ignition.

It is of prime importance to eliminate potential ignition sources for such dust by the provision of electrical

Figure 13 — A boiler explosion can cripple production.

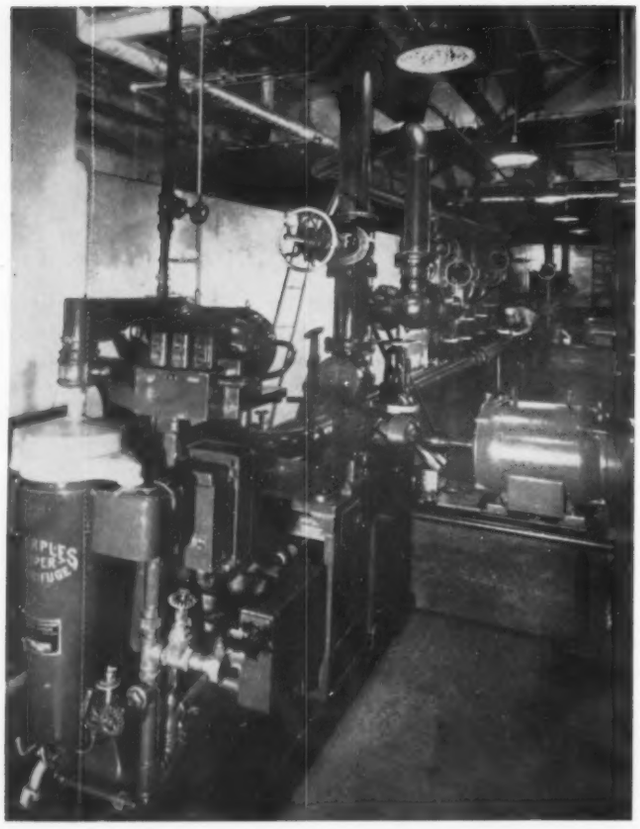


Figure 14 — The normal location and hazards of oil cellars make necessary automatic fixed fire extinguishing equipment. Either water spray or carbon dioxide are well adapted for this.

equipment conforming to the National Electrical Code for Hazardous Locations, Article 500, Class 11, Group F. This provides the required protection for arcing devices against the possibility of igniting airborne coal dust.

Welding in such an area can be perilous and, therefore, should be prohibited.

The use of magnetic separators, preferably of the permanent magnetic type, provide means of removing tramp iron which is a safeguard procedure almost universally followed in the handling of solid fuel.

The storage and handling of fuel oils, from tank farm to process heating equipment, should be so protected that a fire involving oil can be quickly controlled and extinguished before reaching a magnitude too great to handle with fixed extinguishing equipment. Specifically, bulk storage tanks at the tank farm should be provided with fixed foam generating equipment, diked, vented, grounded, grouped and spaced all in conformance with recognized standards.

Where oil is used as either primary or standby fuel for boilers, furnaces, preheating equipment or dryers, burner safeguards are essential. They should be chosen and arranged in a fashion that will assure that no unburned fuel can discharge, vaporize and be subjected to delayed ignition, as this is the "recipe for an explosion."

Instrumentation for such burners should assure that there is a proved pilot or ignition source before the main burner fuel can be admitted to the combustion chamber, and even then arranged to light off on low fire. This procedure should be accomplished only after the combustion chamber has been properly purged prior to ignition and only after the flow of primary and secondary air has been established through interlocks between air supplies, blowers, induced and forced draft fans (as in boilers) as well as having established adequate atomizing agent pressure when oil is used. Interruption in any of these elements, essential to safe burner operation, should quickly arrest the discharge of fuel. This is particularly necessary when equipment operates at temperatures substantially less than the ignition temperature of oil, as in the case of dryers, or during the period of lighting off furnaces and boilers prior to the time that the furnace or combustion chamber has reached a temperature above the ignition temperature of the fuel.

Having set forth basic safeguard procedures, it is recognized that in the steel industry a great deal of process equipment operates continually at exceedingly high temperatures and brief interruptions in flame continuity may not cause trouble. Therefore, the so-called flame failure shutdown safeguards are not generally considered necessary on continuously operating high temperature equipment. However, other interlocks, protecting against the loss of combustion air, a power outage and abnormal fuel pressure that might seriously affect fuel-air ratios, are essential to safety and uninterrupted production.

Figure 15 — Characteristic pattern of foam-water spray sprinkler.

Figure 16 — In 1½ min after fixed foam system operated, substantial fire-killing foam blanket builds up on typical 400-ft tank car unloading siding.

Another basic safeguard which is frequently overlooked involves the provision of adequate emergency fuel shutoff facilities. These would include remotely operated valves, properly sectionalized, so that the discharge of oil under pressure from a broken pipe or fitting can be quickly arrested before a fire of sizable magnitude can develop. Failure to provide such emergency shutoff facilities has resulted in many fires making headway and bringing about near total destruction of a building. However arranged, oil distribution piping should be so equipped with emergency shutoffs so located that they will be accessible when needed.

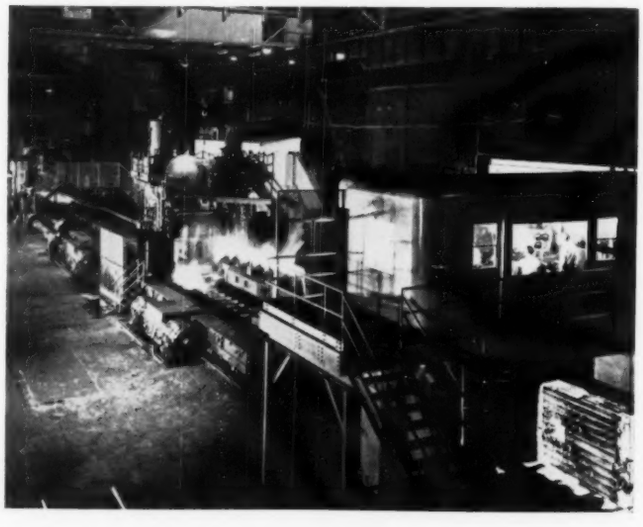
What has been said above for the control of fuel oil, also applies to the distribution of fuel gases. That is to say, that protective interlocks should be arranged to quickly arrest the flow of unburned fuel gas before delayed ignition can result in a severe explosion. Again, it is realized that the steel industry is an extremely large producer of fuel gases and not all the conventional type of industrial interlocks are practical; nevertheless, it is basic fire safety that piping and equipment handling such fuel be so arranged that an uncontrolled discharge or accumulation of unburned fuel gas cannot develop and terminate in an explosion.

SAFEGUARDING ROLLING MILLS

Probably the severest hazard in rolling mills develops around the storage and actual use of coolant and lubricant oils used in process, particularly in the oil cellars. The oil cellar hazard is sufficiently obvious that it is almost universally recognized that fixed automatic fire extinguishing equipment is very necessary. This protection normally is provided in the form of automatic water spray or carbon dioxide. Either system, if properly engineered, should accomplish prompt extinguishment. The choice is up to plant management, but it is proper to recognize a basic difference in the two types of protection.

Carbon dioxide is especially well adapted to the extinguishment of fires involving burning liquids and its use will not increase the extent of physical damage. No damage to electrical equipment from the carbon dioxide should be expected. However, after the gas has been dissipated by thermal upcurrents, ventilating facilities and general atmospheric dilution, a reflash or reignition can occur if even a small ignition source persists in the area. This calls for a second shot of carbon dioxide.

Figure 17 — The future of America largely depends on our ability to keep the steel mills rolling.



The safeguarding of motor rooms from which mills are driven has already been discussed. However, it might be noted at this point that when using a central supply of carbon dioxide for such motor room protection, whether fixed or manual, it frequently is possible to use that same central supply for the oil cellar, providing the fire cutoff between motor room and mill is sufficiently complete to segregate the two hazards.

Fine water spray is also well suited to the extinguishment of an oil cellar fire. An obvious advantage is that reignition is unlikely, but if it does occur, there is virtually no limit on the extinguishing agent discharge time. There seems to be some apprehension as to the use of water spray in the presence of these coolant-lubricant liquids. If storage in the oil cellar is in closed watertight tanks, it is unlikely that contamination can take place. If damage to electrical equipment is feared, splash canopies could be provided to protect vital equipment from direct water discharge. Motors, of course, should be off the floor by a reasonable clearance, if drainage facilities from the oil cellar are difficult to provide.

The purpose of a fire extinguishing system is to kill the fire, and either type will do just this.

In the use of coolants and lubricants on the rolling mills, there is a tendency for some to vaporize and recondense. This is more conspicuous in some plants than in others, and varies with the type of oil used. Where this condensation occurs sufficiently to develop an oil residue on interior building surfaces, particularly the underside of the roof and ventilator structures, automatic sprinkler protection is necessary. Unfortunately, in noncombustible structures, such protection over rolling mills is seldom provided, but that does not detract from the importance of providing such means of checking a fire at the roof when it can support itself on this oily residue.

SAFEGUARDING BY-PRODUCTS—BENZOL PRODUCTION GROUPS

Probably more concentrated fire fighting power, using both fixed and portable equipment, is required at the by-products and benzol areas than in any other section of a full process steel mill. With the increased use of outdoor type of process installation, the protection problem has in general been somewhat simplified. Ventilation and explosion relief is no longer a problem in these open areas which formerly were walled in, such as the still house. While such improved design for these hazardous areas has reduced the probability of a serious fire occurring, the inherent hazards are still sufficiently severe to justify a fixed installation of fire extinguishing equipment; specifically, approved water spray sprinklers or "fog" spray heads on deluge system, arranged to protect the naked steel structure, and also the water spray engineered to adequately envelop all portions of the process equipment which can be seriously damaged by a bad spill fire. This type of fire is usually at grade or first floor level where an escaping liquid may come to rest. Total protection for this ground floor area is, therefore, exceedingly important.

For this, water spray, deluge operated, is highly effective, providing the cooling needed to protect structure and equipment so exposed by a spill fire. However, the industry should not overlook the advantages of newly developed and approved foam water sprinklers which are normally arranged to discharge mechanical foam, in spray form, for a predetermined period. Such a system lays down a fire-killing foam blanket with excellent uniformity and brings about extinguishment using less water ultimately than may be accomplished with conventional water spray alone, though the actual rate of discharge in gallons per minute is about the same.

As a matter of interest, at one benzol plant in the chemical industry, the fixed automatic foam spray system went into operation as a hot product escaped from process equipment. The escaping flammable liquid disappeared beneath the foam blanket whereby ignition was prevented. In this respect, the system operation actually performed as a means of fire prevention, though designed as a fire extinguishing system. There is an added advantage to this type of "two-way" protection in that the foam producing compound, or stabilizer, can be shut off as soon as extinguishment has been accomplished, while the system is operating, without shutting off the discharge of water spray. In this manner, any tendency for reignition to occur is minimized, if not virtually eliminated, as the water spray discharge continues to cool the atmosphere. As water spray falls into the foam blanket, the fire-killing characteristics of the foam are not impaired. This same type of protection is well suited for use in transfer pump rooms, where escaping product can produce a disruptive fire.

Storage tank facilities for flammables should rigidly conform to current standards governing the diking, venting, grounding, grouping and spacing of all tanks, as should the installation of fixed foam fire extinguishing equipment and the required foam generating facilities.

The electrical installation at the by-products and benzol plants should conform to the Code requirements for Hazardous Locations in all areas wherever such equipment may lie in the path of flammable vapor travel in the event that there is a spill or an escape of product outside the closed process equipment. Likewise, careful attention should be given the feature of grounding, which should periodically be instrument checked.

MAINTAINING AN EFFICIENT PRIVATE FIRE DEPARTMENT

Fixed fire extinguishing equipment will provide, where needed, reasonably adequate means for coping with the majority of fires, providing the water supplies are adequate, the distribution piping is free of obstructions and sediment, and all manually and automatically operated control valves are open. Where fire may involve a considerable amount of rapidly burning material, or specifically flammable liquids, it is certain that the use of water spray or foam hand hose will be necessary as well as the use of other portable extinguisher equipment. This requires manpower—and it is necessary that such assistance be available "around the clock." In order to avoid confusion and the general misapplication of fire-fighting tools when an emergency strikes, a well organized and well trained private fire department should be maintained.

Such a department serves no useful purpose unless it is adequately manned and well equipped to handle any fire likely to occur, at least until the public fire services arrive to augment the fire fighting force.

This fire fighting equipment should not only include a supply of standard fire hose arranged so that at least two effective hose streams can reach any point in the plant, with, of course, a distribution of hydrants that will make this possible, but also one or more motorized units that will hasten men and equipment to the emergency without delay. It is not possible to establish a guide as to how many men or how much equipment should make up the private fire department organization, because this depends on the size of the plant, the extent of hazards and construction, as well as the amount of assistance that can be expected from the public fire services; also, how soon they will be at the scene of the fire after being summoned.

The organization of manpower for the private fire department should follow conventional lines with a chief, fire marshal, or top fire officer, and on each shift a deputy in charge. Ten men is a reasonable minimum per fire company. Each company should be relied upon to lay and handle at least two hose lines. In addition, there should be on each shift, and part of the fire department organization, an electrician and an engineer familiar with the requirements of starting fire pumps, foam generating units and other apparatus likely to be used in an emergency.

Manpower and equipment alone do not make a private fire department. It requires a well-developed program of training, education and fire drills so that men not only are thoroughly familiar with equipment that is needed for the control of various types of fires that may be encountered, but also the technique in handling such apparatus. It requires not the casual knowledge gained from reading books and from lectures, but practical usage in the field on actual test fires. In many states, there are fire officer drill schools as part of the state, county, or municipal fire training programs, and attendance at such sessions is highly recommended.

Part of the responsibilities of the private fire department should also include the maintaining of a plant fire prevention program. Self-inspection is the most effective means of preventing the occurrence of avoidable fires. Defects and deficiencies within the plant, pertaining to fire safety, can be brought to light and corrected by a self-inspection routine before there is opportunity for trouble to develop. Self-inspection alone does not accomplish the desired results unless there is an effective follow-up system whereby defects are brought to the attention of those who are in a position to promptly correct deficiencies disclosed. By assigning this self-inspection work to one or more members of the private fire department, depending upon the size of plant, valuable training of fire department personnel results, namely, that of being constantly aware of potential hazards and the development of methods for combating them.

In view of the general expanse of steel mill property, a coded fire alarm system connected to audible alarms will greatly expedite the mobilization of fire fighting strength in an emergency with the least delay. Again, one or more pieces of motorized equipment is highly essential and also serves as a nucleus around which the

private fire department can be trained.

In order to closely co-ordinate the activities of the private fire department with those of the public fire services likely to respond, it is well to plan in advance with the public fire department as to the most efficient manner in which to meet a given emergency wherever and whenever it arises on the property. Frequent visitations by fire officers of the public fire department whereby they may become familiar with the exact location and type of hazards, as well as fire protection equipment provided therefore, will pay off when a fire emergency does arise. There will be less delay and more fire fighting efficiency resulting from such close co-ordination and co-operation between the private and public fire fighting personnel. In this direction it is most important that one or more public fire alarm boxes be located on the premises so that public fire department assistance can be summoned promptly and without necessarily being dependent upon use of the telephone.

Inasmuch as 85 per cent of industrial fires can be handled in their early stages with portable equipment, it is, of course, of paramount importance that there shall be an adequate distribution of hand hose and the proper type of fire extinguishers throughout the premises to provide for the handling of spot hazards as well as general protection. In order that the proper type can be quickly identified for use on any given kind of fire, each extinguisher, or at least the post upon which it hangs, should be given an identifying color stripe, and in addition, each unit numbered so that the right extinguisher will go back in its correct location after being recharged. Failure to apply the proper extinguishing medium on a small fire can result in sufficient delay before putting the correct type to use, that a fire can quickly spread out of control.

SUMMARY

It has been necessary in the foregoing presentation to treat the fire protection of steel mills in a general way. To be more exacting or specific as regards construction, occupancy and protection would border upon the development of fire protection standards for the steel industry. This not only does not come within the scope of this paper, but the subject could not be adequately covered within the space available for such presentation. Rather, it has been the author's purpose to bring together information which may assist the steel industry in rechecking its own protection methods in the interest of safeguarding production.

It is not uncommon throughout American industry to find that in the desire to improve production in both quality and quantity, heavy expenditures are made in periodically replacing production equipment with ultramodern streamline installations, without providing for the necessary protection that will assure uninterrupted production. With competition so very acute and the margin of profit generally slim, a serious shutdown resulting from fire or explosion can have a most serious effect on the present and future status of a business. Since the future of America largely depends on our ability to keep the steel mills rolling, the purpose of this paper will have been served if sufficient interest is provoked in steel mill fire safety that each mill operator will return to his plant determined to recheck on his protection methods, and promptly arrange for the correction of any deficiencies that such a survey may disclose.

Not only fix it, but "FIX IT BEFORE THE FIRE."

Discussion

PRESENTED BY

FELIX C. RODGERS, Vice President, Cardox Corp., Chicago, Ill.

C. V. BATLEY, Insurance Surveyor, Bethlehem Steel Co., Bethlehem, Pa.

E. B. RUMBLE, Manager of Special Hazards Dept., Automatic Sprinkler Corp. of America, Youngstown, Ohio

R. M. L. RUSSELL, Assistant Chief Engineer, Factory Insurance Assn., Hartford, Conn.

Felix C. Rodgers: The presentation by Mr. R. M. L. Russell fully portrays his experience as a fire protection engineer and his ability to present it plainly.

I would like to comment, however, on the various hazards, by name, that you have with you in your operations daily, but perhaps do not consider them serious until something happens.

The outstanding hazards are enumerated in the paper, but our experience and association with various steel fire protection groups would produce a list as follows:

Oil Quench
Oil Cellars
Oil Storage
Mill Stands
Paint Dips
Dryers
Ovens
Air Filters
Ventilation Ducts
Benzol Plants
By-Product Hazards
Motors
Control Rooms
Transformers
Switchgear
and the Power Plant Hazards
- Generators
- Synchronous Condensers
- Oil Filters
- Hydrogen Purging
- Coal Bunkers

These are known to us as "Hot Spots." The most likely places where fire will occur. Protection of these areas should be a must in any complete protection system.

All of these hazards have been protected by low-pressure carbon dioxide systems in various steel mills.

Some of these hazards are by nature more easily and more completely protected by carbon dioxide than by any other media.

Naturally, being associated with a company that has researched, pioneered, manufactures, engineers and

installs carbon dioxide systems, we know better its possibilities and limitations.

But, fire protection in industry has to be reliable and also practical. Getting back in operation is very important in your industry as well as any other. No damage is incurred by carbon dioxide and as quickly as the original cause of the fire and the fire damage itself can be remedied, you are ready to operate. No quench oil to purge, no paint dip tanks to drain and replenish, no motors to dry out, etc.

No spread of fire is promoted as may often be the case with flowing flammable liquids helped along with water, or other media.

Oil cellars or congested areas are particularly suited to carbon dioxide as it penetrates every area, above, below or behind obstructions. Carbon dioxide being a gas, will penetrate everywhere the flame supporting oxygen can. Most oil cellars are a conglomeration of pipes, valves, pumps, etc., that are practically impossible to protect fully with any fire extinguishing media which is not in gaseous form.

Another phase of protection which rightly comes under the heading of "Safe Guarding Steel Production" is purging or inerting.

Purging implies that the unwanted gas is completely displaced, while inerting implies that the combustible gas or air is merely diluted to make the contained atmosphere inert.

Carbon dioxide has been used for these operations in many mills. Time saving over other methods proves more economical besides being more positive. One application involved the purging of the entire blast furnace gas system to allow general repairs. Nearly 100 tons of carbon dioxide was required.

Some plants have 3 and 5-ton carbon dioxide fire trucks, which can be used also in these operations.

Fire protection should be designed into the mill. It should be a part of the budget, not something that will be taken care of, "if we have any money left." Fire protection may be the wisest part of the expenditures.

The design of the fire extinguishing application should be handled by experienced fire protection engineers with the help of operating information that can be provided by the steel mill engineers and operators.

Make certain that all of the hazard is protected. It will do little good to protect one central part of the hazard without providing means for extinguishing fires in associated hazards that might become involved.

Insist upon a fire protection system providing a reasonable safety factor. This can be done by providing more than the bare minimum of required carbon dioxide, or other media, by providing hose reels to protect fringe areas where necessary, and by providing double shot storage systems in critical cases. An engineer, for example, designing a pressure vessel with steel is required to use a safety factor of at least 4 to 1. If this safety factor is required in a product as carefully controlled as steel, it should not be considered unnecessary when dealing with fire and explosion problems.

Fire protection and prevention should be designed to provide a practical, convenient and positive means to accomplish same.

C. V. Batley: The fact that this paper is included in the agenda of a meeting of the Association of Iron and Steel Engineers is most encouraging to those in the field of fire protection engineering. It is a strong indication of interest in the fire safety of your plants. Such an interest is needed for the satisfactory solution of this problem.

I would like to comment briefly on Mr. Russell's general approach to fire protection and to suggest several qualifications to that approach in applying it to certain specific hazards in the steel industry. I am in hearty agreement with the importance he puts on automatic sprinklers, provided, however, that we restrict their installation to situations where they will function satisfactorily.

The outstanding record that he has indicated has been built up under certain conditions, namely, installations in areas of small or moderate size and of moderate height. Basically, the successful operation of automatic sprinklers depends on the heat from the fire rising vertically and fusing the sprinkler heads over the fire. Such buildings as our shops, laboratories, storehouses, warehouses, coal galleries, offices, for example, can generally be successfully protected by automatic sprinklers.

Sprinklers will not be as effective, however, in large open areas with high roofs, and by this I mean buildings 100 to 300 feet wide, and 500 to 1000 feet long, with roofs of 30 to 90 feet in height. And, when several such buildings are placed side by side and freely communicate, some having roof ventilation and others having none, unsatisfactory conditions for effective sprinkler operations are compounded. The general construction of many of our operating buildings, in some of which hot and molten metal is present in various stages of processing, and the difficulty of providing adequate and suitable water in many areas make it necessary to study carefully each specific instance where sprinklers are being considered.

Mr. Russell states that 85 to 90 per cent of all fires are comparatively small at their inception and that extinguishment of them can be accomplished at that time with comparative ease. Our records of the fires which occur in the steel industry indicate that 95 to 98 per cent can be extinguished in this stage. And contrary to the experience of general industry, it is practical in the steel industry to have an extinguisher at the point of origin in time to extinguish the starting fire around the clock, day by day.

In support of this statement, I offer the following: The industry, in general, works around the clock, day by day. At Bethlehem we keep a record of every starting fire. In our fully integrated steel plants over the past 15 years, we have a record of about 120,000 starting fires. Careful study of these records indicates that 95 per cent of these fires were extinguished without calling the fire department, and about half of the remaining fires were extinguished before the department arrived. This indicates that up to 97 to 98 per cent of the starting fires are extinguished at their early stages by plant employees using portable equipment. I think this record compares favorably to the record of automatic sprinklers, and I also feel that this pattern is not unique with the Bethlehem organization. Therefore, the steel industry in general appears to take the following approach to the fire problem: First, provide adequate, suitable extinguishers, keep them properly maintained, and instruct the plant employees in their use. Next, de-

velop a good private fire department. Equip and train it properly. As Mr. Russell pointed out, the fire department can perform the very useful function of plant inspections. Probably our greatest source of fires is poor housekeeping, which can be corrected by such inspection. The fire department also can maintain the plant fire equipment and can instruct plant personnel in the use of such equipment. The next step is to equip all buildings with automatic sprinklers, where this protection will be effective; and provide special spot protection against the hazards where it can be justified.

Mr. Russell has covered the whole field of steel plant fire protection very completely and, except to suggest a few problems that might be of interest to discuss further at this meeting, I have little to add.

In spite of the excellent record I have cited on the extinguishing of small fires with portable equipment, there is always a chance that one of these fires will get away. Where automatic sprinklers can be used effectively, there is a second line of defense against major loss. In the high-roofed, large open-area buildings that cannot always be effectively protected by automatic sprinklers, we have the potential, in many cases, for heavy losses. The limitations of manual fire fighting in such buildings has been demonstrated. We have pointed out the problem of adequate water supply as well as the problem of venting smoke and heat caused by the fire; and in some of these large buildings we have, unfortunately, a good deal of combustible construction. What steps can we take to prevent catastrophies in such situations?

In choosing fire protection equipment, the selection of a reasonable factor of safety is of utmost importance. The standards for the design of fire protection equipment give minimum requirements. What should the practice be in regard to increasing the factor of safety where the hazard is more severe than ordinarily? This question is especially pertinent in fixed protection where the amount of the extinguishing agent is limited, such as in carbon dioxide systems. Because of the misunderstanding of what the standards provide, which are too often thought of in terms of maximum requirements, this question should be asked more often than it has been, if effective systems are to be designed.

Another problem is the use of nonflammable hydraulic fluids. Their widespread use in hydraulic equipment is a very complex problem which must be solved.

Fire protection must be engineered as carefully as other operating factors in our plants, if we are to get the maximum value in loss prevention for every dollar that is spent, and this means that the fire protection engineer must have help. Let us briefly review the problem. First, the hazards must be located either by inspection of the plant or by a study of the plans of new construction. Here the fire protection engineer can do an excellent job.

The next step is a complete evaluation of the hazards involved, including their place and their potential effect on the continuity of production. This can only be answered by the operating people. Then we must determine the most economical way to provide the degree of protection that can be justified. The operating people, the maintenance people, and others including the fire protection engineer, must have their say on this point.

The method selected then has to be engineered and the specifications drawn up to insure that the selected method will function as intended. The fire protection engineer will be of great help here. The project must be carried out. This is up to management. We must also remember that a maintenance program for fire equipment must be developed and executed, for, like any other equipment, it needs maintenance. The cost of maintenance must always be considered when evaluating fire protection.

So we all must work on this problem, if we are to insure the benefits of well engineered fire protection.

E. B. Rumble: Our contact in this field is basically the recommendation of types of fire protection equipment to be installed for spot hazards. Such protection, of course, costs money which must be justified, either from an insurance requirement or the improvement of operating facilities.

Fire protection expenditures on operating units can be quite easily justified when the expenditure is considered as part of operating equipment cost. For example: Let us assume that you have designed a rolling mill. The expected usage of the mill is 10 years; however, one set of rolls would be good for only one week's run. In order to keep the mill operating, it would be necessary, therefore, for an investment to be made in spare rolls to keep the mill operating full time. An engineering analysis for fire protection of any mill or operating unit can easily be considered in the same manner as any other portion of equipment which may fail and shut down the mill. Assuming that the useful life of the mill is expected to be 10 years, if the mill is out of operation for one week, the loss would be about 0.2 per cent of the profit expected.

We know of one case where a downtime of a mill operation meant the loss of $25,000 per day profit and the fire protection system installed was equal in cost to the loss of production for one day. It is not uncommon to consider an adequate fire protection system being worth at least a week's downtime, although there have been very few cases where a full and complete fire protection installation for spot hazards has cost as much as the potential loss of one week's downtime.

Many engineers are now using given periods of mill shutdown time as a guide for the amount of expenditure which is reasonable for any given fire protection project. In other cases the fire protection has been classified as increasing mill life or efficiency on an arbitrary basis.

If you are called upon to evaluate fire protection, the use of these ideas can be very helpful.

R. M. L. Russell: Mr. Batley challenges, I feel, this feature of sprinkler protection from the steel operator's viewpoint. I do not take exception to what he has said, but, in view of the fact, by his admission and general knowledge, that steel mill buildings are exceedingly high, particularly those using older type, asphalt, asbestos-coated metals that propagate flame, it is in that type of building where I personally feel that sprinkler protection is badly needed. Some large losses have occurred from that combination. Such high buildings are admittedly out of range of portable protection and until such buildings are replaced with noncombustible type of construction, where combustible construction exists, I feel that sprinkler protection is exceedingly important. ▲

An Automatic Gage Control System for Tandem Cold Mills

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AUTOMATIC gage control is a field that has become active only in the past few years. The reason for the present interest is obvious. It is essential that automatic gage control be used on today's high-speed mills. Even on relatively low-speed mills, if the highest possible yield is to be obtained, automatic gage control is necessary. Varying degrees of success have been achieved by systems of varying complexities.

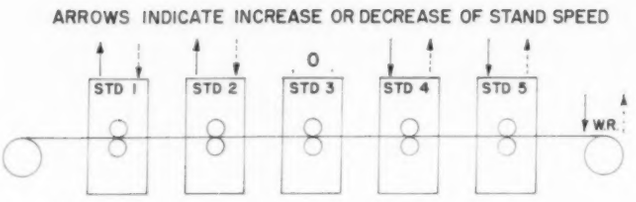
Practically all automatic gage control systems have one aspect in common. They are designed to control gage by the same methods used by the operators except to do it automatically. This control is no exception.

Development of this control started from discussions between the author's companies. Experimentation on the mill and study of the system have been carried on simultaneously. The final control system is the result of a co-operative venture.

INITIAL EXPERIMENTATION

Initially at the mill a system working into the normal field circuit of the last stand motor was devised. Even in this crude system, the possibilities for automatically controlling the gage of a tandem mill were seen. As expected, the gain possible in this closed loop system was limited if stability was to be maintained. Therefore, the system required too much steady-state error to be used most effectively. A very crude integrating system was built to remove this steady-state error left by the direct system. It proved to be a definite improvement.

. . . . automatic gage control has progressed to a point where it warrants consideration on all new mills . . . . it may also offer advantages on existing mills . . . . it is necessary to coordinate mill drive and automatic gage control to obtain optimum performance . . . .



CONDITION	CORRECTIVE MEASURE	STAND SPEED CHANGES	
		1 & 2	4 & 5
---OVERGAUGE	INCREASE TENSION	DECREASE	INCREASE
—UNDERGAUGE	DECREASE TENSION	INCREASE	DECREASE

Figure 1 — Basic method of gage control is shown by block diagram.

Further study of the system led to the belief that more effective control of the mill could be had by working into the armature circuit of the motor rather than into the motor field. This eliminated the rather large time delay of the motor field where no regulator was available in favor of an existing fast-acting generator voltage regulator. This, of course, proved to be another improvement. The system was further improved by feeding a correction signal into other stands as well as the last one.

The gage coming off the mill by now showed definite improvement and the control was considered a success. It was, however, realized that there was still room for improvement. The system was working fine, but it was working at its limit. Further refinement of the system would require improved equipment that was more versatile and more easily adjustable in order to optimize the system. A new controller was built to replace the experimental equipment. It was designed to be as versatile as possible yet simple and dependable.

PRESENT SYSTEM

Figure 1 shows the manner in which the mill is adjusted in order to control delivery gage. A correction signal is fed into all stands except the center one which serves as a reference stand. The signal is also fed into the winding reel. If an overgage condition occurs, it is necessary to increase the reduction taken to get back on gage. To increase the reduction, the tension is increased throughout the mill by slightly increasing the speed of the latter stands and slowing down the entry end. If an undergage condition occurs the opposite takes place—tension is decreased by increasing the speed of the entry end and slowing the delivery end.

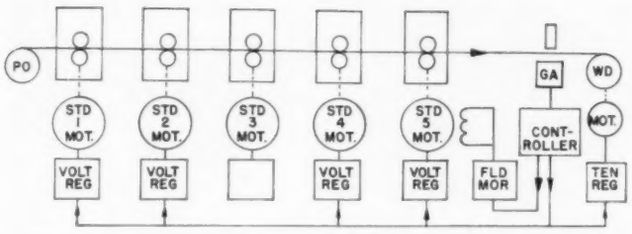


Figure 2 — Automatic gage control system receives deviation signal from x-ray gage.

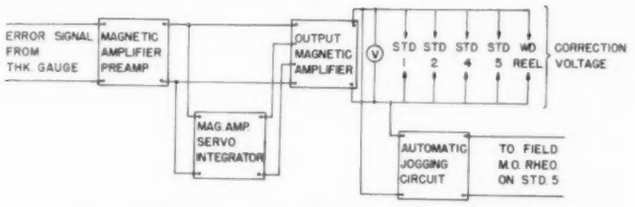


Figure 3 — Main controller block diagram.

Most errors in gage occur somewhat gradually rather than abruptly. By working on the tension throughout the mill a smoother correction is achieved and a more balanced mill is maintained.

Figure 2 is a pictorial schematic of the mill and control system. A gage deviation signal is obtained from the x-ray thickness gage between the last stand and the winding reel. This signal is fed into the controller which in turn feeds a correction signal into the various stand voltage regulators, and the windup tension regulator. A signal also is sent to the field motor operated rheostat if the correction to the stand regulators approaches its limiting value.

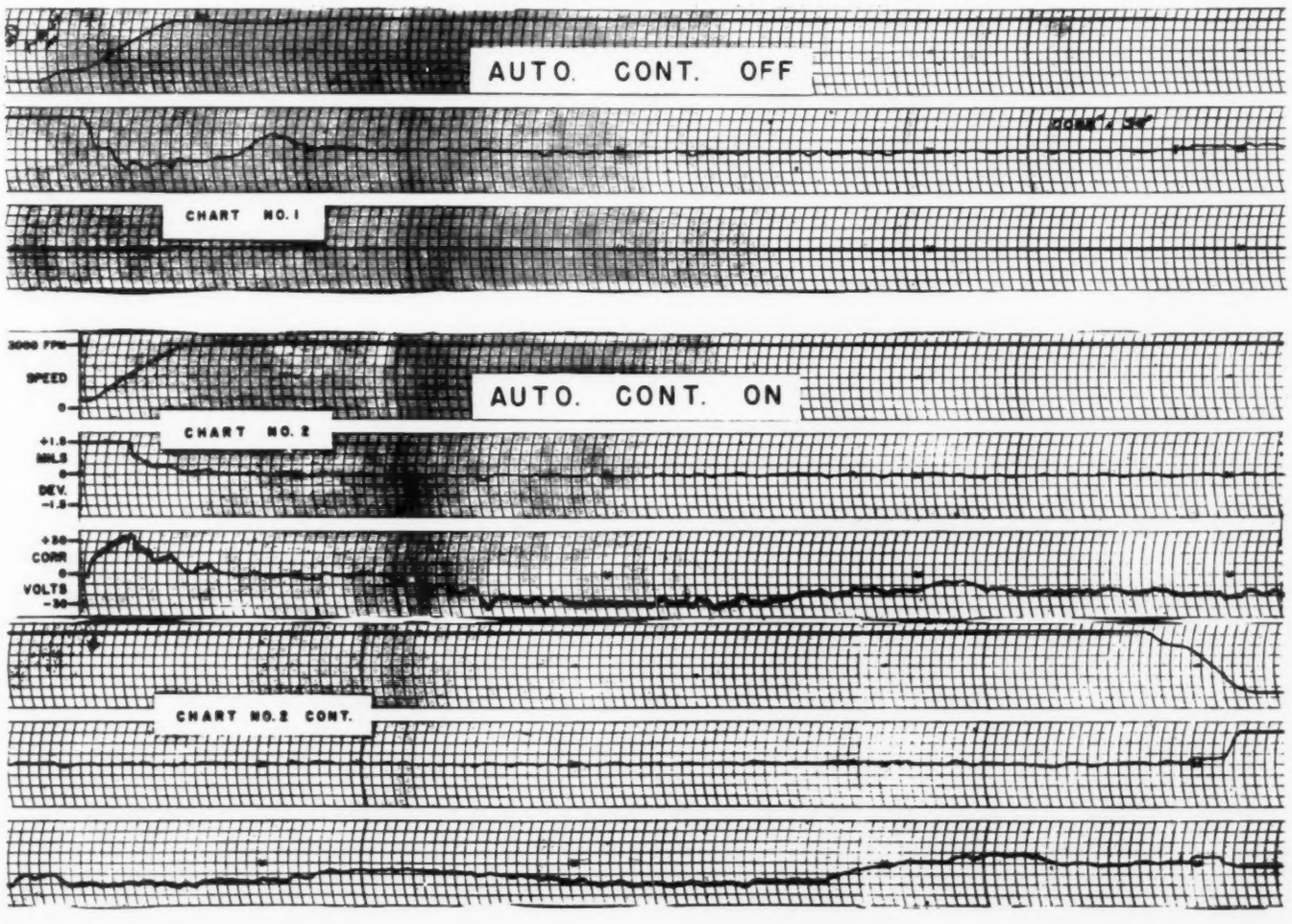
CONTROLLER AND SYSTEM OPERATIONS

Figure 3 shows the controller only. The error or gage deviation signal obtained from the x-ray gage comes to a magnetic pre-amplifier where it is raised to a convenient voltage level. This signal is fed directly into an output magnetic amplifier which supplies the correction signal to the various stand regulators. In addition, the integral of the error voltage is fed into this output magnetic amplifier from the magnetic amplifier servointegrator. This integrator signal is used to replace the small steady-state error that remains in any proportional regulator such as the direct system. A proportional system can be made to respond more rapidly than an integrating system for the same degree of stability, and with this combination, both a fast and accurate system is obtained that can be easily set up and adjusted.

The magnitude of control signal applied to each stand regulator is independently adjustable. In setting up the control system, however, each will have to be set with due consideration to the others. Each one has an effect on the over-all system. The settings, however, are not too critical and are set according to the operating procedure used on a particular mill.

There are certain limits that must be taken into account when automatically controlling gage. Exces-

Figure 4 — Gage charts were taken on startup of Gary mill.



sive tension change must not cause strip breakage. Rated voltage on the drive equipment must not be greatly exceeded. In this particular case, 5 per cent overvoltage was considered a sufficient maximum for desired results. To obtain a definite correction limit, the output magnetic amplifiers are adjusted to saturate completely at the desired correction voltage.

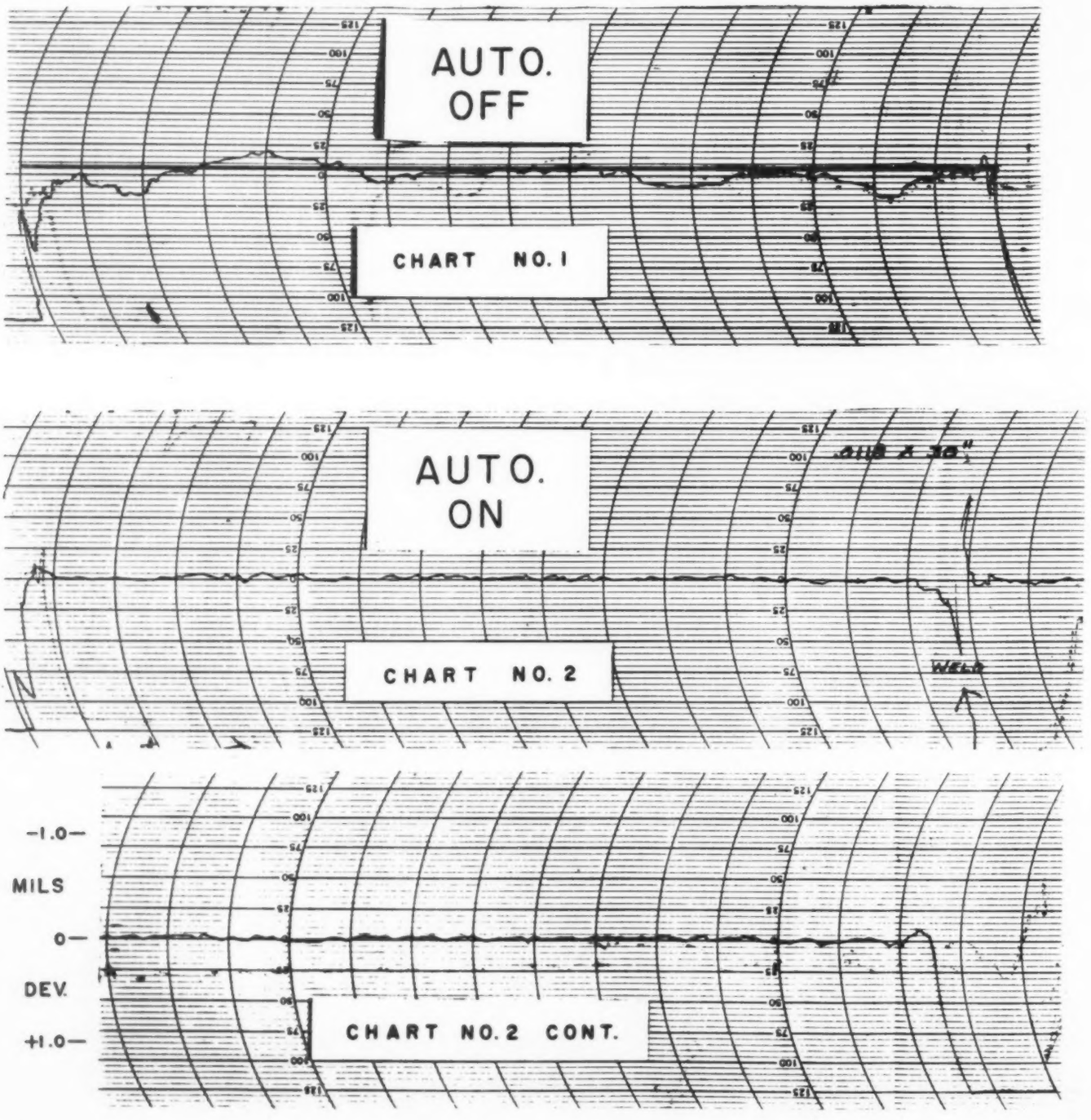
When the correction voltage does approach its limiting value another control circuit operates. On this installation the stand motor field rheostat is automatically jogged to bring the controller back into range. In other cases it may be desirable to jog the screwdowns to keep the basic controller within range.

The method used depends on the operating procedures used on a particular mill.

INSTALLATION AND STARTUP

Installation and startup of this new control went very smoothly. While the controller was being built, arrangements were being made to install it. Before it was shipped it was tested and all possible adjustments were made. The control was then shipped and installed. During the next week-end mill shutdown following the installation, the control was connected into the main mill regulators. It was rechecked and made ready for use upon restarting the mill on Monday. All that remained was to turn in the desired amount of control to each stand and to adjust the circuit for proper stability. Within the first hour the control was operating effectively. A few days were spent in observation and testing.

Figure 5 — Gage charts of recent tests show better results of deviations through body of coil.



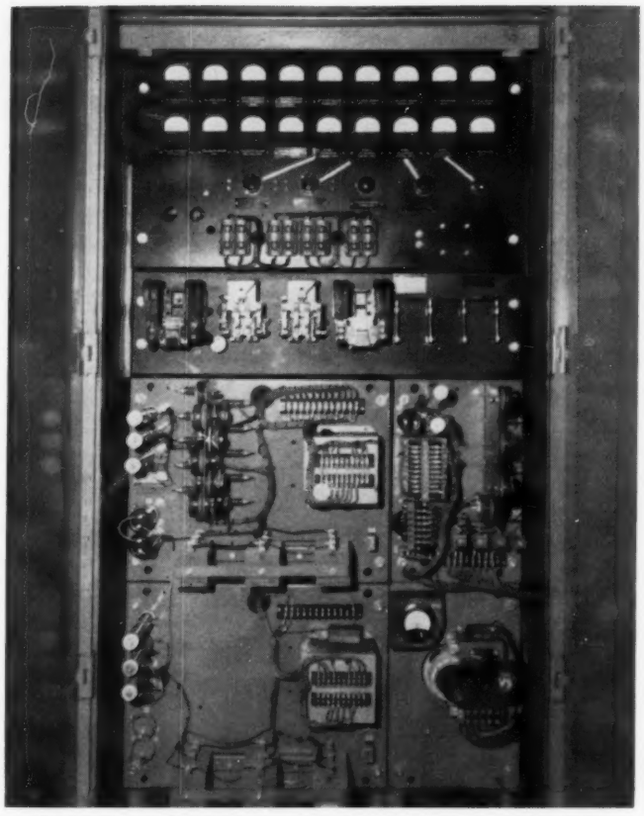


Figure 6 — Front view of automatic gage controller.

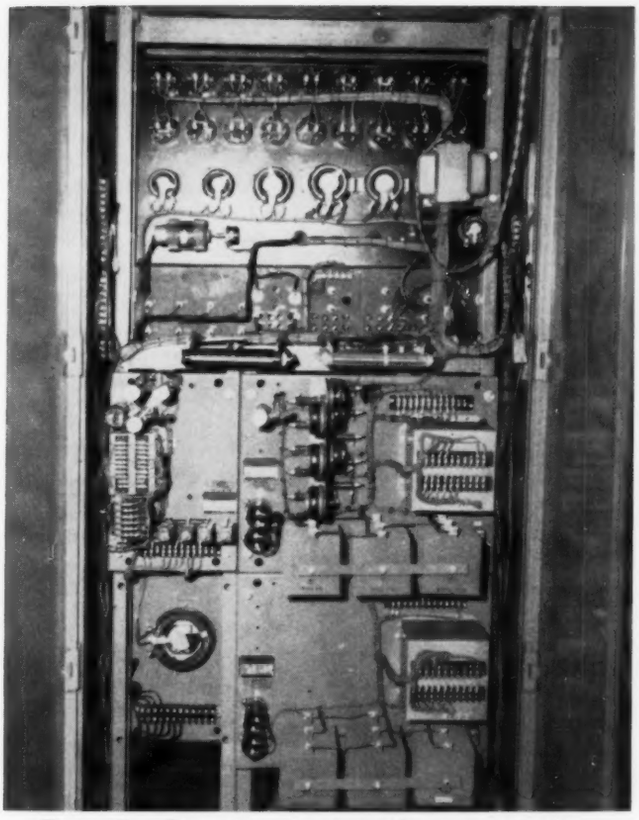


Figure 7 — Rear view of automatic gage controller.

At no time during installation or startup was production interrupted.

Figure 4 shows a set of charts taken on the Gary mill. The top chart shows a typical startup with the automatic control off. Due to the scale it is not easy to see the gage errors through the body of the coil, but it is apparent much is to be desired. The second chart is a complete coil with automatic control. The mill comes on-gage smoothly during acceleration and remains accurately on-gage through to the end of the coil. These charts were taken during the first two days' startup tests.

Figure 5 shows a different type of chart which compresses the coil so as to show deviations through the body of the coil better. These were taken recently.

Figures 6 and 7 show pictures of the actual controller cabinet as installed. Figure 6 shows a front view with the cabinet doors open. Figure 7 is a rear view of the same.

It is seen that the controller consists of industrial type equipment and is not unnecessarily large or complex. Maintenance on the system is expected to be negligible as static (magnetic amplifier type) control has been used wherever practical.

COMPUTER WORK

Due to the tremendous interest of all parties involved, the success of this project was practically insured from the start. However, it goes without saying that the design and development of a system such as the one just described requires considerable time and effort. Rolling steel on a 5-stand tandem mill, or any mill for that matter, is an extremely complex operation in which many variables are present. In studying a system of this sort it is almost impossible to arrive at any practical solution by "slide rule" calculations. However, the analog computer, which has come into universal use within recent years, is a tool which can be used to great advantage in gage systems design. Since it was desired to be able to set up a system on the computer which would match the mill operation as closely as possible, a special precision laboratory type tape recorder was obtained to accurately represent the various transport time delays.

Figure 8 is a picture of this special machine. On this machine the tape is used to represent the strip, the recorder represents the roll bite and the pickup device represents the measuring gage. From this it can be seen that the time it takes for a point on the tape to move from the recorder to the pickup device is the actual transport time delay.

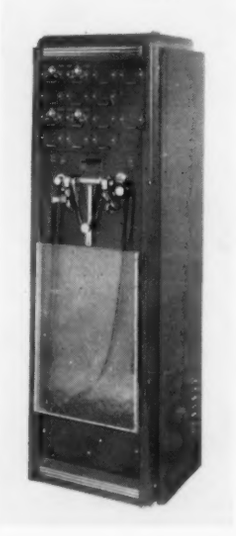


Figure 8 — Special tape recorder was designed to provide transport time delays.

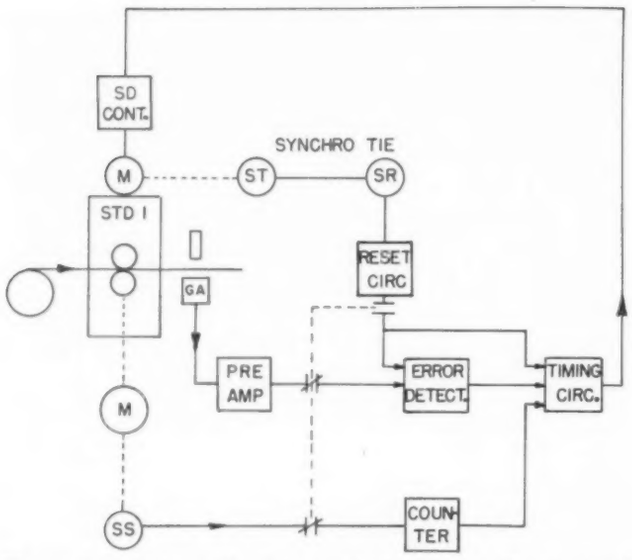


Figure 9 — Automatic gage control used on No. 1 stand screws.

Considerable time was spent in the computer laboratory in studying the various phases of automatic gage control. However, there is one very important point to remember—"the proof of the pudding is in the eating" and control systems of this type also require the use of a mill in order to check the results of a computer study. The development of this system progressed along two lines—computer studies and experimentation on the actual mill.

As previously stated, a computer study is somewhat limited in its ability to analyze completely a control system for a large and complex mill such as a tandem cold mill. The success one has depends, to a large extent, on his knowledge of mill control and mill operation. The mill regulators are an integral part of an optimum automatic gage control system, and they cannot be neglected if the most effective system is to be obtained.

SCREWDOWN CONTROL

Another phase in the development of automatic gage control concerns itself with screwdown systems. Although not considered to be as effective as the tension system described, a screwdown system can be used in conjunction with a tension system quite effectively. Figure 9 is a block diagram of an automatic gage control system as applied to the No. 1 stand screws. The error signal is taken from the gage and amplified in a magnetic amplifier and then fed to an error detector. If an error greater than a predetermined value exists, a signal will

Figure 10 — Front view shows automatic gage controller for first stand adjustable voltage screwdown control.

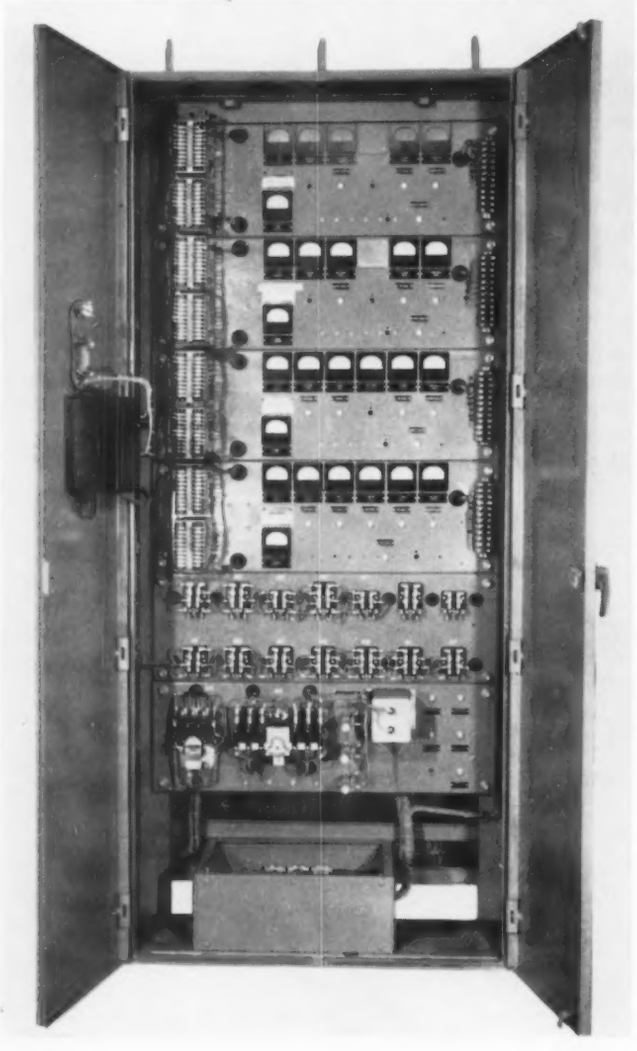
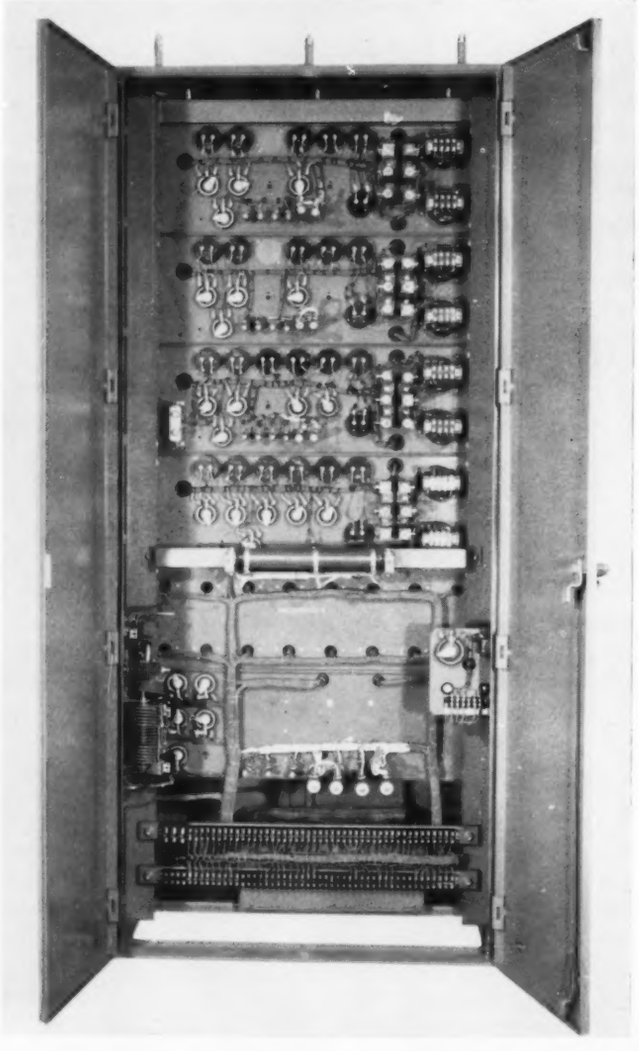


Figure 11 — Rear view shows automatic gage controller for first stand adjustable voltage screwdown control.



be transmitted from the error detector to the timing circuit. The timing circuit is initiated by the sampling switch and the counter, which are, in effect, measuring strip passing the roll bite. Measuring the strip passing the roll bite is necessary to insure that once the system has made a corrective action, it will not operate a second time until the measuring gage has had a chance to see the effect of the first corrective action. The length of time that the timing circuit will jog the screws will be a function of the gage error at the instant the timing circuit initiates the screwdown jog. A synchrotie reset servo is supplied to automatically reset the screws when the strip leaves the mill so that they will be in their original position when the next coil is threaded through the mill.

Figures 10 and 11 are front and back views of a screwdown automatic gage control system recently built for the No. 1 stand of a high-speed 5-stand tandem cold mill.

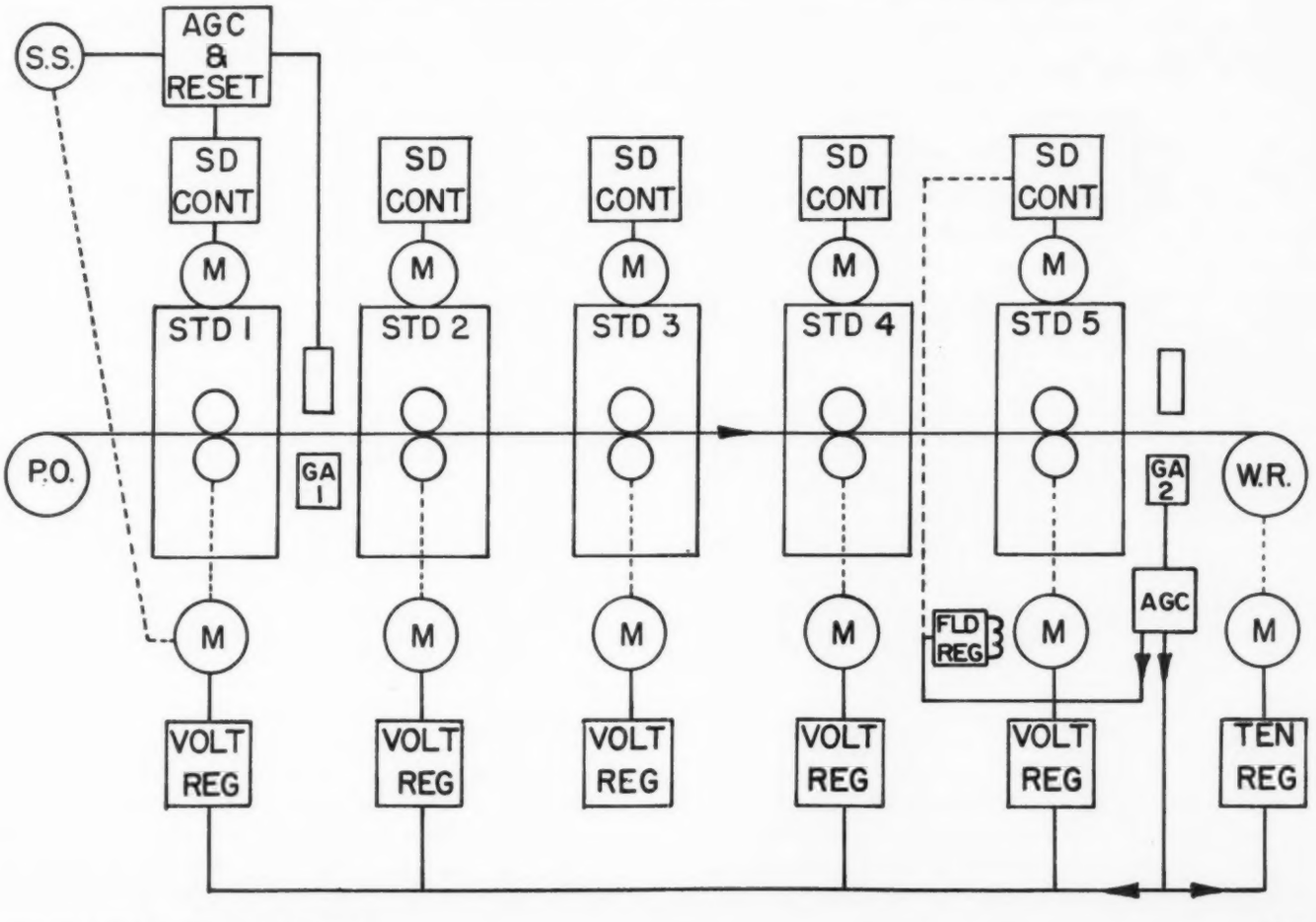
COMPLETE SYSTEM

Figure 12 is a block diagram of a five-stand tandem mill equipped with automatic gage control utilizing tension and screwdown control. Tension is increased or decreased within limits throughout the mill with the center stand remaining as a fixed reference. The amount of tension change for a given error can be adjusted individually for each stand and also for the reel. It is also possible to adjust the tension limits over considerable range. Intelligence for the limited tension adjustment is obtained from the gage just following the No. 5 stand. Tensions are adjusted by recalibrating the stand voltage regulators slightly and also by recalibrating the reel tension regulator slightly. It should be noted that when the signal from the automatic gage controller reaches a predetermined level, the field control of the No. 5 stand will be recalibrated a slight amount to insure that the integrating motor-operated rheostat in the gage controller will not tend to run out of range. The voltage level necessary to cause the field recalibration can also be adjusted over a wide range. It will also be possible on some schedules to jog the No. 5 stand screws to help maintain gage. However, on extremely light gage it will not be desirable to use the screws on this stand. Introduction of the gage controller output into the reel tension regulator allows the reel control circuit to anticipate to some degree the speed change of the No. 5 stand and thus respond more rapidly. It should be noted that the intelligence for all changes in stand voltage, the No. 5 stand speed change by field calibration and the jogging of the No. 5 stand screws is obtained from one gage controller.

The control for the No. 1 stand screws receives its intelligence from a separate controller which, in turn, receives an error signal from a gage just following No. 1 stand. This screwdown controller along with the reset feature is the same as the one shown in block diagram form in Figure 9.

Although this paper has dealt with the automatic gage control as applied to a 5-stand tandem mill, the controller, consisting of the preamplifier, the integrator

Figure 12 — Schematic shows over-all gage control for five-stand tandem cold mill.



and the power amplifier, is standard in design and can be applied to any steel rolling mill where gage can be controlled by tension. It is also applicable to aluminum mills where gage is controlled by tension or mill speed—or by a combination of both.

Automatic gage control, although still in its infancy, has progressed to a point where serious thought should be given to its use on all new mills. It will also be desirable to investigate the possibility of properly applying automatic gage control to many presently existing mills. The need for closely co-ordinating the mill drive and the automatic gage control should be evident if optimum performance of the mill is to be achieved.

Discussion

PRESENTED BY

R. A. PHILLIPS, Application Engineer, Analytical Engineering Dept., General Electric Co., Schenectady, N. Y.

J. E. REIDER, Metals Division Manager, Industrial Nucleonics Corp., Columbus, Ohio

R. L. DOWELL, Assistant to General Superintendent, Columbia-Geneva Steel Div., United States Steel Corp., Pittsburg, Calif.

I. G. ORELLANA, Project Engineer, Electrical Laboratory, Republic Steel Corp., Cleveland, Ohio

J. F. KOSTELAC, Assistant Electrical Superintendent, Crucible Steel Company of America, Midland, Pa.

N. S. WALKER, General Maintenance Foreman, Tin Mill Cold Reduction Dept., Gary Sheet and Tin Mills, United States Steel Corp., Gary, Ind.

JOHN W. WALLACE, Mill Systems Development Engineer, Control Engineering Dept., Westinghouse Electric Corp., Buffalo, N. Y.

J. W. COOK, Steel Mill Engineer, Industry Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

R. A. Phillips: It is interesting to see that the analytical studies and operating experience which have been described in this paper have led to a stand 1 control which is similar in all of its features to the one which we installed at Irvin Works, U. S. Steel Corp. two and one-half years ago. The system, which measures by x-ray gage the thickness deviation of the strip leaving stand 1, moves the screws an amount proportional to the deviation, and waits to initiate further correction until the change can reach the gage, has proved its merits as a method of keeping the speed changes required by the vernier control within practical limits.

In addition, the screw reset feature which we pioneered is also included. Although it is not included on all competitive controls, we have found it very important.

The authors describe an analytical study which is similar to those we have made. However, it is surprising to us that the conclusion drawn from the study was to develop a vernier control, the first installation of which is described in the paper, which changes the speeds of stands 1, 2, 4, and 5. Our studies have shown that the fastest possible vernier corrective action is obtained when the speeds of stand 5 and the winding reel only are changed. The only transport time in the control loop is that between stand 5 and the x-ray gage. This is short. However, if other stand speeds are changed in addition, there will be additional gage changes earlier in the mill. These must progress through the mill until they are measured by the x-ray gage. This involves a long equivalent transport time. As a consequence, it is not possible to achieve the high speed of response to gage variations that our field experience has shown to be necessary.

J. E. Reider: We also have had a very important part to play in the development of automatic gage control systems. The first such system was an automatic screwdown control system which was installed at the Republic Steel plant at Niles, Ohio, in January of 1954. This system has been generally accepted throughout the industry for tandem mills producing blackplate for tinplate or zinc coating.

We also have a similar type of system for use as a speed or a tension controller. The system is simpler for application on a variety of tandem mills than the one described by the authors of this paper. It essentially controls the field voltage on the last stand drive motor. The simplicity of the measuring system using a radioactive isotope in place of the x-ray tube and the simplicity in the controller make them very attractive for the steel producer to investigate, having, as they operate, lower maintenance costs and less downtime, and certainly producing comparable results.

R. L. Dowell: We have worked closely with Mr. Walker on this control, and we have a similar installation which is performing satisfactorily. Mr. Walker is certainly to be congratulated on pioneering a new system, which, as far as we know, is a new approach.

One question I have concerns what degree of deviation will actuate the correction from stand 5? Also, in the case where a gage was used on stand 1, what degree of deviation was established to actuate corrective measures?

The other question I have concerns the application of this control on a mill which is operating at designed speed and horsepower. In installing such a system, what changes would have to be made in delivery speed or horsepower because of installing such a system? To apply this control to a mill already fully loaded, it appears it would be necessary to reduce the nominal speed to have available horsepower for regulation and control.

The third question concerns recalibration for the voltage change. What limits were placed upon that recalibration?

I. G. Orellana: From the charts presented by the authors, it is apparent that their automatic strip thickness control maintains close gage tolerance on the finished cold strip. Our experience on cold strip mill gage control has shown that the thickness variations existing in the original hot bands affect the final results in the cold mills. What was the gage variation in the hot bands coming to this particular cold mill?

In this screwdown and tension control system, No. 3 stand of a five stand tandem mill is used as a pivot. If this system were used on a four stand tandem mill, which mill would be the pivot? Also, would this control system be considered for a three stand mill?

Member: I have three specific questions that I would like to put to the authors of the paper.

While our experience has been extremely limited on tandem mills, we have close to 50 installations of auto-

matic screwdown control in operation, and I have three questions that from our experience are quite important, in order to establish the value of the paper.

First of all, on the charts of the finished product you had recordings, and as Mr. Orellana of Republic pointed out, the upward tolerance seemed to be extremely close. I was curious as to what type of recorders these were, what type of response these recorders had, and were these recorders showing what was actually coming out in the product or were they showing what we would like to see our product be?

Secondly, on the corrections for the various stands, did you find the final setup of the corrections going to the individual voltage regulators, and are these proportional to the reductions that were being taken for each stand? Could you not just apply a tension correction to all the stands, and expect the strip to stay together? I presume there was some kind of proportion there, and I was curious about the amount of reduction taken for each stand.

At the Gary mill what gage was being used on stand 1? They said they were using an x-ray on stand 5, and I wondered what gage was being used on stand 1.

J. F. Kostelac: I would like to ask the authors one further question to extend Mr. Orellana's question on a three-stand mill. Assume a three-stand mill has many short orders, and about 100 different types of steel, will this gage apply to such a mill?

N. S. Walker: In answer to Mr. Phillips question about transport time, we find that for a five-stand mill the strip coming from the hot strip mill does not change instantly in thickness, the change is gradual over a long portion of the strip, thus, by using the motors on the reel, No. 5, No. 4, No. 2 and No. 1 stands, we get a quick response at No. 5 stand and at the reel motors, and a stabilizing effect on the mill by spreading the error correction signal throughout the other stands on the mill. All of the mill stand motors will work together to correct the gage. If you would use No. 5 stand motor alone, you would increase the tension between No. 4 and No. 5 stands only and would have increased strip breakage especially when rolling light gage. Strip breakage is decreased when using all stand motors to make error corrections.

For example, let us say that the maximum correcting voltage is 5 per cent on a 600-volt system, this would be 30 volts. No. 5 stand motor would receive the full 30 volts, No. 4 stand motor would receive 12 volts, No. 3 stand motor would not change, No. 2 and No. 1 stand motors would receive the signal in reverse direction, No. 2 stand motor receiving 6 volts and No. 1 stand motor receiving 12 volts.

When gage signal is heavy—The control will speed up No. 5 and No. 4 stand motors, while slowing down No. 2 and No. 1 stand motors, thus increasing the tension on the strip between all stands simultaneously.

When gage signal is light—The above procedure is reversed, slowing down No. 4 and No. 5 stand motors, while speeding up No. 1 and No. 2 stand motors, reducing tension on strip between all stands simultaneously.

This explains the advantage of using all mill stand motors, you get a quick change and by using all the motors you keep a balanced mill.

Mr. Dowell asked about the limit of voltage change. The voltage change is limited to 5 per cent which on a 600-volt system would be 630 volts maximum.

I believe this covers all the questions in regard to the automatic gage control system on cold strip mills. There were some questions on the application on hot strip mills which I will refer to Mr. Wallace for answering.

John W. Wallace: I feel that Mr. Phillips may have missed the spirit of our paper. We have presented one approach to the problem of gage control after considerable study of the subject.

Most of the actual pioneering in the field of gage control was not done in this country but in England by the British Iron and Steel Research Association. Significant papers on the subject were written previous to 1950.

Mr. Phillips mentions that the first stand control system shown in block form in this paper is essentially the same as that used previously by his company. As shown by the remarks of Mr. Reider, there are several companies using this same basic approach for first stand control. I think it is quite logical that in analyzing a problem such as this that different engineers would come to similar conclusions. As stated in the beginning of the paper, most automatic gage control systems attempt to control gage by the same methods used by an operator. The system cited by Mr. Phillips is not different in this respect.

The main difference, I think, would be in the components used to build the control, and there may be some minor points as to the type of thickness gage or how the timing is varied. The timing on the control shown is not proportional to error. It is a time that is adjusted to be more closely the job time necessary to remove a given error. The necessary time is not directly proportional to the amount of error due to contactor delays and motor acceleration-deceleration period. However, many systems have been set up to time the job proportional to error.

Mr. Phillips is right in that the fastest control is obtained by changing stand 5 and the reel. The transport time from the entry stands to the gage is considerably longer and we do have to limit the amount of correction fed into these stands in order to maintain stability. The system is set up something like this. If we limit the correction voltage on the stand motors to ± 5 per cent change, that would be ± 30 volts, as this is a 600-volt mill. We have set up stand 5 to take the full excursion of ± 30 volts. Stand 4 will respond to a maximum of ± 20 volts, stand 3, of course, is not changed. Stand 2 is set for a maximum of approximately ± 10 volts and stand 1 for ± 5 volts. Thus the gain is reduced as the transport delay is increased. As for these corrections disturbing the latter stands as they progress through the the mill, we have not found it to be troublesome. The major correction does occur at stand 5. The mill operators feel that in spreading the correction out a bit the mill is kept more balanced.

This control contains both fast and slow responding portions. A fast system is necessary to bring the mill on-gage quickly, but fast corrections are not essential after the mill is up to speed. However, in this control the slower responding integrating system acts to keep the faster direct system at the center of its operating range for more accurate control through the coil body.

Mr. Dowell has asked about the sensitivity of the con-

trollers. In the case of stand 5 the control is sensitive to any change the thickness gage will measure. In the case of stand 1, screwdown controllers from one-half to one thousandth is usually considered sufficient. There is no use in operating the screwdowns needlessly. Another aspect of the sensitivity is stability of the control. If the time of operation of the screws is not precise for the degree of deviation causing them to move, a larger dead zone may be required to reduce overshoot. If a system is properly designed, ±0.5 mil is a practical sensitivity for a tandem mill of this type. This gives approximately one per cent accuracy out of stand 1.

Mr. Dowell also asked about horsepower limits. On this mill they are not using all the speed or horsepower available. On a mill that is fully loaded it would, of course, require some change to use the system. Some mills are only fully loaded near the delivery end and part of the load can be shifted back to stands 1 and 2 to enable control to be used on 4 and 5.

As for recalibration by jogging the stand 5 field rheostat, the number of jogs can be limited if desired. On this mill recalibration is seldom needed and is mainly necessary if the operator has not set up his mill correctly at the start of a new schedule. If the mill is set reasonably close to optimum conditions the overlimit control is never energized. This is generally the case. If it is energized, a small change is all that is required. Once the operators understand the problem this automatic recalibration is not needed as they can easily keep the controllers within its range.

Mr. Orellana asks about the hot band coming to this mill. Mr. Walker will have to supply this information. Hot mill charts from several mills show that in most cases the error is in the shape of a taper in gage from one end to the other. Other deviations are produced by the loss of tension as the tail end leaves each stand of the hot mill. We have seen this appear on the output of the cold mill without gage control but I have not seen it appear with our gage control.

If this system were used on a 3-stand mill I doubt if a pivot stand would be advisable. It probably would be best to just control stand 3, and use screwdown control on stand 1. On a 4-stand mill, stands 2 or 3 could be used as a pivot. It is somewhat dependent on the mill whether the pivot system is desirable.

The test charts were made with an oscillograph which has a frequency response close to 100 cps. The charts taken more recently were on a recorder without any amplifier. Its response would be slower. However, it can be seen on the chart without gage control that the recorder is responding reasonably well to the variations in gage. There is no reason to suspect that it would act differently with automatic control.

Most variations occur gradually enough to be recorded by any instrument of this type.

At the Gary mill, a beta-ray gage is used on the first stand. Provisions have been made by others for using this gage to control the screws on stand 1. We have not found a noticeable difference in the delivery gage of the mill whether the first stand control was used or not. Some rollers use it and some do not.

J. W. Cook: I believe that Mr. Walker and Mr. Wallace have answered most of the questions which were raised. However there are just a few comments I would like to make.

Mr. Reider stated that a gage control system controlling delivery gage by controlling field voltage on the last stand is simpler for application on a variety of tandem mills than the one described in the paper. We believe that the reference is to a system where the motor operated field rheostat is jogged by intelligence from a gage to either increase or decrease entry tension to the last stand. Although a system such as Mr. Reider refers to may be simple to install, it is extremely slow in response due to the inherent long time delay of the motor field. Even on systems where a motor field current regulator may be used, the response of the system will be delayed by the frame delay of the motor.

Mr. Dowell had a question on what error was necessary for a correction. The integrating servo recognizes any error and reacts to remove that error. It allows no practical error to exist. The direct (or proportional) system responds to remove it immediately, and the integrator follows up to take out any small error which must exist to produce an output from the direct system. In an extremely short time, the entire error is removed.

Mr. Kostelac raised the question on how the gage would work on a three-stand mill rolling small orders and many different alloys. The only thing I can say to that is that we ourselves do not make a gage. However, our system will operate from any gage which will produce a deviation signal large enough to operate a standard deviation instrument. As for rolling a wide range of alloys, it may be found that it will be necessary to change the gain of the system for different alloys to provide optimum performance for all. ▲

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ASSOCIATION OF IRON AND STEEL ENGINEERS, 1010 EMPIRE BLDG., PITTSBURGH 22, PA.

The Growing Canadian Steel Industry

by D. S. Holbrook, President
Algoma Steel Corp. Ltd.,
Saulte Ste. Marie, Ontario, Canada

Address presented at General Session of the 66th General Meeting of the American Iron and Steel Institute, New York, N.Y., May 21, 1958

. . . . the American government can well emulate the Canadian government's policy on depreciation which, instead of hampering growth and sound operation, stimulates expansion and efficient practice.

IT is an exceptional honor to speak as a Canadian to the American Iron and Steel Institute. Such an invitation is recognized as a compliment to the Canadian industry, and as a genuine demonstration of the democratic nature of this Institute in its willingness to hear a voice from such a small segment of the trade.

The time has long since passed when Canada was considered a nation mostly made up of Eskimos, Indians, Englishmen who didn't know how cold it was and Frenchmen who knew which side of the Atlantic their bread was buttered on. In recent years, there has been a continuing effort to throw more light on relationships between Canada and the United States. There have been many speeches made with the intention of paving the way for a clearer understanding between the two nations. I have no such lofty contribution this morning and wish to speak only about the iron and steel industry.

The program erroneously states that I am here to make an address. This is much too ambitious. What I wish to bring before you this morning can be better termed a report on the progress of our industry in Canada, particularly with respect to its recent growth and development. And then, since our industry has doubled its ingot capacity and more than trebled its investment in the last ten years, I would like to make some observations on one factor which has contributed largely to the development of the industry—favorable depreciation tax regulations.

I have elected to discuss depreciation because I believe it is a critically important issue with you, and that our government in Canada has shown better understanding of the problem than has yours. I further believe that we in management must promote a clear knowledge of the importance of the depreciation problem, since it affects all of us.

It is not an academic thing. It's the reason why the blooming mill superintendent cannot get a new battery of pits to replace the museum piece that Julian Kennedy installed in 1903, and it is the reason why there are still steam locomotives chugging around a few of the mills.

If a blast furnace operator had a 5000-lb coke rate, or an open hearth operator was getting ten tons an hour from his modern furnaces, he would not be around long enough to worry about it. And yet this is the kind of a performance which is taking place in the "depreciation end" of the business and is accepted by too many people in the industry as only an accountant's problem.

THE INDUSTRY

The Canadian steel industry of today principally consists of four integrated companies with an aggregate capacity of 5,375,000 ingot tons per year; the largest with a capacity of a little more than 2,250,000 tons and the smallest about 900,000 tons. There is also a large alloy steel company and a dozen or so smaller mills melting scrap in small furnaces or rerolling purchased steel. All together, ingot capacity amounts to about 6,000,000 tons per year. This report discusses the experience of the integrated basic iron and steel companies, and does not specifically consider the alloy and rerolling mills. This is in no way neglecting their importance; it is just that their experience is more special than the industry's as a whole.

Although the Canadian steel industry is more than 70 years old, the development of the modern industry, as we know it today, can best be summarized in three periods: pre-1939, 1939 to 1949 and 1949 to the present.

Pre-1939—Until the start of the Second World War in 1939, the prosperity of the steel industry in Canada had been very spotty. In the early 1900's the great demand for rails for building Canadian transcontinental railroads furnished much of the stimulus for the industry, and this was followed by the boom and resulting steel expansion of World War I. By 1920, Canadian ingot capacity had reached 2,000,000 tons per year but with disproportionate financial strength among the producers. Much of the money earned during the World War I years had been spent on plant for which there was no use following the war, and the industry was over-

expanded. All through the 1920's the average rate of operation in Canada was only 50 per cent of capacity and profits were not widespread. As a result, the depression, starting in the early 1930's, necessitated extensive financial reorganization of several of the companies.

The most striking commentary of the state of the industry in Canada between the wars is that its capacity did not appreciably expand from 1920 to 1940, while, in the United States, capacity had risen by one-third, or 20,000,000 tons, in this period.

1939–49—With few exceptions, the advent of World War II in 1939 found the Canadian steel industry with plants poorly maintained and unprepared for the emergency. There had been no blast furnace capacity added in the previous 20 years; less than ten per cent of the open hearth capacity was of then modern construc tion and between the wars only two companies had built rolling mills. A very strong effort was made by the steel companies, encouraged by the government in much the same manner as in the United States, to rehabilitate plant and add capacity. Blast furnaces and coke ovens were built, and annual ingot capacity was increased by approximately 1,000,000 tons during the war. Blooming and heavy plate capacity was installed and the industry gained some semblance of its present form.

During the war and, in fact, the decade from 1939 to 1949, the Canadian steel industry was badly lacking free enterprise; construction, production, prices, profits and most critical phases of the business were closely regulated. Steel capacity at the end of this period stood at about 3,000,000 tons annually.

1949–Present—By 1949, however, price controls, excess profits tax and steel allocation controls had been successively dropped and the industry was "on its own." The postwar Canadian industrial boom, then only beginning to gain impetus, provided Canada with a strong and continuing steel demand. This demand was stimulated by a tremendously expanding capital investment, fast population growth triggered by heavy immigration and a rising standard of living. I will not quote a lot of statistics, but it is significant to say that all of these growth factors have been proportionately greater than those in the United States in the same period.

A government which, during the war and postwar period, had imposed very strict controls became anxious to encourage the Canadian iron and steel industry to modernize its plants and expand to meet the needs of industry in times of steel shortage.

On January 1, 1949, the Canadian government replaced straight line depreciation regulations with a much more realistic declining balance system and, in 1951, greatly encouraged growth by providing accelerated amortization for a program of iron and steel expansion approved at that time.

In recognition of such heavy demands and in a relatively favorable depreciation tax allowance atmosphere, the Canadian iron and steel industry has expanded so that by the end of this year it will have added some 3,000,000 tons annual ingot capacity since 1949, doubling its size in ten years.

The growth of the United States industry in the same period makes a 3,000,000-ton increase look small by comparison but, to the Canadian industry, this has been a giant stride. I will not detail here the new installations which have been made, but the growth has been much more significant than the measure of increase in ingot capacity alone would indicate. The growth has been deep and sound and not accomplished solely by additions to melting capacity. I believe that Canada is the only country in the non-Communist world where increase in ingot capacity has been accompanied by proportionate increase in blast furnace capacity. Basic production equipment has been brought up to date and auxiliary equipment greatly improved.

This growth can best be expressed in terms of 1957 production:

Eighty per cent of the coke was made in ovens built in the last ten years,
Forty per cent of the hot metal was produced from blast furnaces built in the last seven years, and
Fifty per cent of the ingots came from furnaces built in the last seven years.

The development of primary rolling and finishing capacity has been very impressive. Two new blooming mills have gone into production in the last 18 months and a third is scheduled for the year end. At least 75 per cent of the hot rolled steel was produced on mills new or completely rebuilt since the mid-forties. Cold rolled steels, galvanized sheets and tinplate have made the same rapid progress with almost all the highly finished steel forms produced on mills built in the last ten years.

For the most part technology has kept apace with the United States. Raw material beneficiation and blast furnace practice is sound; open hearth production is better than average, and a new oxygen steel plant, the first in North America, pioneered in this field. By the end of this year, 20 per cent of Canada's steel capacity will be in oxygen steel installations.

And so, the Canadian steel industry has become a modern industry with a great deal of energy and confidence. In summary—in the first 50 years, capacity reached 2,000,000 tons; in the next ten years, another 1,000,000 tons; and in the last ten years, an additional 3,000,000 tons!

Although Canada, as a nation, has grown by leaps and bounds, a measure of the relative progress of the steel industry is that it has increased in rank of importance in Canada, as measured by value of its output, from fifteenth 20 years ago, to tenth ten years ago, to sixth last year.

So much for this brief picture of the Canadian industry. Canada is growing and, although there is a pause at the present time, the prospects for long term growth continue to be excellent and steel ingot capacity is predicted to double in the next 20 years. This means that the industry will have to add some 6,000,000 tons of annual ingot capacity at a present day cost of over $2,000,000,000.

This is a very large sum of money, even by United States standards. To the Canadian industry, it appears colossal and makes the whole issue of continuing and expanding capital investment a very important long range problem. I believe it is of ranking importance to you.

In attracting a continuing supply of additional capital, however, the steel industry must assure the investing public:

First, that its present investment is and will be given greatest possible protection against shrinkage from inflation, and

Second, that its fixed assets are replaced regularly enough to keep the industry's efficiency high, its products competitive and its investment profitable.

PROTECTION OF INVESTMENT

In the United States, and repeatedly from this platform, much emphasis has been placed in recent years on the profound effect of inflation on the steel industry because of its exceptionally heavy investment in long life plant, and the inadequacy of normal depreciation tax allowances to compensate for inflation.

In spite of the difference in size of our two industries, the effect of inflation on plant investment has been a common one. To use Mr. Fairless' analogy of two years ago, we have both been running just as hard as we can in trying to stay in the same place. The fact that we in Canada have had to start further back in the race and have gained a little bit in the running, gives us some small license to make a few observations on the common problem.

Inflation seems to be with us as a built-in characteristic of our economy. Most heavy equipment in steel works has a life of at least 25 years, and there has been no time in the history of your country or ours when money has been as valuable as it was 25 years earlier.

In the steel industry, money in the form of not only plant but also working capital and investments (unless they are equity investments) is deteriorating in real value each year. As the dollar has steadily eroded at a recent rate of approximately five per cent a year, many words have been written, tabulations prepared and graphs drawn to measure the effect of this erosion on investment and reinvestment. To me the simplest and most painful conclusion is that the only real profits are represented by earnings on invested capital in excess of the first five per cent required to "stay even" with previous years' investment values. As the steel industry in the last ten years has earned only a little more than ten per cent annually on its investment, the size of the problem is self-evident.

In protecting investment, we in Canada enjoy one distinct advantage over you and that is the Canadian government's treatment of depreciation allowances for tax purposes.

Up to 1949 we had straight line depreciation tax allowances closely corresponding to those in the United States. But, effective January 1, 1949, the Canadian government abandoned the concept of straight line depreciation and adopted a deliberate policy whereby the basic rates of depreciation for Canadian income tax purposes are not intended to reflect the estimated lifetime of particular properties involved as is the case in the United States. Instead, the Canadian government adopted a reducing balance system of depreciation with varying percentages of write-off. Heavy machinery and equipment such as coke ovens, iron and steelmaking furnaces and rolling mills, qualify for a 20 per cent write-off of the reducing balance. This has the effect of making possible the recovery, for tax purposes, of more than two-thirds of the cost of such facilities in five years.

A second important regulation is that, in Canada, a full year's depreciation allowance is granted on acquisitions made at any time during the year. This enables us, for instance, to get back 20 cents out of every dollar paid during the year on progress payments for heavy equipment in the course of manufacture. This is particularly helpful to the smaller company with limited financial resources in planning its capital budgets.

This is no "free ride." There are good reasons behind such a depreciation philosophy. The writing off of the major portion of the value of a facility in its early life is consistent with its increasing obsolescence and higher cost of repairs in its later life. The allowance of a full year's depreciation on a project, even if not completed, is also sound. Once a project is committed, the die is cast, the money required is no longer available for other purposes and obsolescence sets in immediately. In support of both of these aspects of depreciation, it must also be recognized that the salvage or resale value of steelmaking equipment is almost nil: there is nothing so useless as a battery of coke ovens or a blast furnace ready for retirement. Steel plant investment must be recovered by operation alone.

There is the often repeated criticism that liberalizing depreciation allowances robs the government of taxes. Such criticism does not properly evaluate the constantly expanding tax base afforded by an efficient and growing steel industry, nor the unmeasured but substantial additional taxes collected by the government through growing secondary steel-using industries well served at fair prices.

We in Canada have heard labor complain that higher depreciation allowances have in some manner enabled the steel companies to grossly understate their earnings. And yet the recent modernization and expansion of the industry has made possible for the steelworkers the highest standard of living of any Canadian labor group.

While the favorable declining balance method of depreciation and rates effective in Canada is not the same approach as the "re-investment depreciation" method currently being studied by the United States steel industry, its net effect is similar since 80 per cent of the investment in plant in Canada has been made in the last ten years—60 per cent in the last six years—in dollars already much "inflated" by usual steel industry standards.

REPLACEMENT OF ASSETS AND THE INDUSTRY'S EFFICIENCY

One effect of a favorable depreciation allowance policy, of course, is that it permits reasonable planning of replacements. The most impressive feature of the Canadian industry's progress has not been its expansion but its replacement and modernization. Today only six per cent of coke oven capacity in Canada is over 15 years old; only 35 per cent of blast furnace capacity is over 15 years old; only 28 per cent of steelmaking capacity is over 20 years old and the oldest blooming mill is 19 years old. The oldest hot strip mill was built in 1945, and old or obsolete auxiliary equipment is the exception.

This thorough modernization has largely been made possible by a cash flow from profits and from depreciation, depletion and amortization allowances estimated

at almost 16 per cent of sales in the last ten years. This is more than one-third higher than in the United States.

In the last ten years, the Canadian industry has averaged an annual depreciation and amortization charge for tax purposes of $9.93 per ton of ingot capacity while, in the same period, in the United States, this has been less than half, with an average charge of $4.83 per ton.

The point has been repeatedly made by authorities in the United States that the special "amortization" granted by the United States government has distorted your depreciation picture, since it is rapidly running out, and normal depreciation alone is woefully inadequate to meet your needs.

In both our countries special amortization granted as a result of the Korean War has distorted property write-offs but in Canada the high early write-off characteristic of our regulations and continuing reinvestment in modernization, has resulted in a rapidly growing normal depreciation account. In 1957 our normal depreciation taken for tax purposes amounted to $10.00 per ton of ingot capacity and this will probably rise with increasing investment in the next several years. In the United States the total of write-offs claimed has been falling in the last several years and without the special "amortization" grants, normal depreciation appears to have been only about $3.50 per ton in 1957.

This is a serious matter for the United States industry; ten years ago you were writing off $3.40 per ton of capacity in regular depreciation and today, $3.50. On a 25-year life, at the present rate, you are getting back less than $90 per ton of annual ingot capacity and yet we all figure today that capacity under $300 per annual ton is a real bargain. As plant wears out, it will be exceedingly difficult to dip continually deeper into earnings to make up the difference and still keep shareholders happy. It will be even harder to convince moneylenders that the steel industry is competitive with others.

The phenomenon of the Canadian industry "pulling itself up by its own bootstraps" may be heresy to accounting purists, but the modernization which has resulted has been a prime reason for improved efficiency and better profit margins for the Canadian steel producers, since steel prices in Canada in the last ten years have risen more slowly than in North America as a whole.

To say that realistic depreciation allowances and improved efficiency through modernization are necessary to keep our industry's products competitive in common markets may seem obvious, but Canada is in a particularly sensitive position with respect to overseas competition. Our market can be smothered easily by the much larger producer nations' steel surpluses, and both we as steelmakers and our customers as steel users have had a surfeit of foreign steel, available on our coasts at $175 a ton one month and $125 a ton a few months later. We cannot control overseas competition and, from a labor cost standpoint, cannot hope to meet it. Modernization seems to be one factor we must emphasize, and steel industry shareholders have a right to expect it.

I have said that we have some small license to comment on depreciation practices because of our experience.

We have had ten years of experience with depreciation tax regulations more favorable than your own. The experience has been enlightening and has been the means of a very real improvement in Canadian steel affairs. We look back with no regret to abandonment of the old regulations and in consequence look forward with far greater confidence to the constructive years ahead. ▲

Revised and rearranged collection of articles which appeared in the Iron and Steel Engineer between 1943 and 1950 . . . a book for rolling mill men and for anyone interested in rolling mills and roll design . . . written from a practical viewpoint by one who has had considerable experience in the art of roll design.

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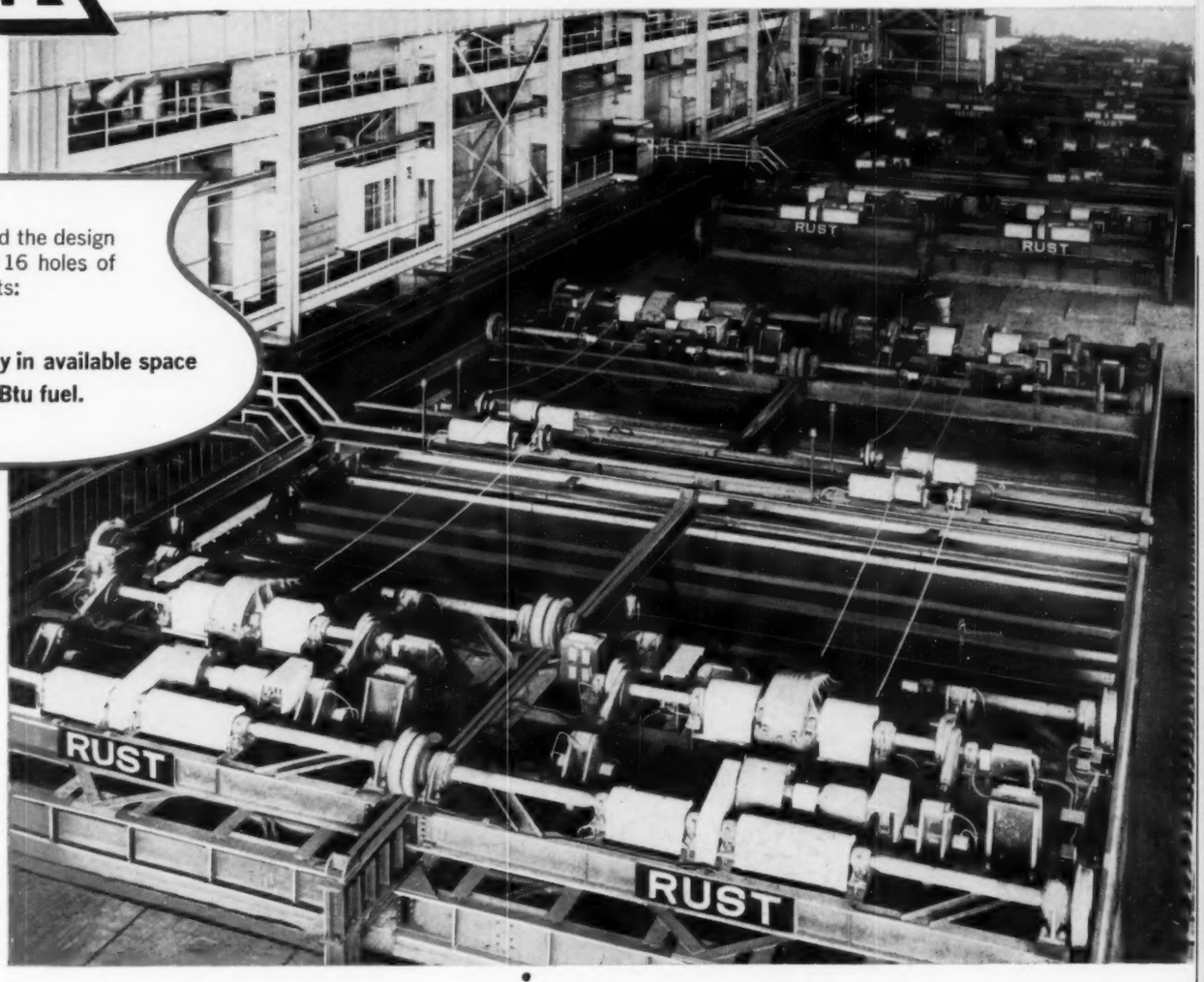
soaking pits

accelerate ingot capacity ... even with low Btu fuel



Three requisites dictated the design requirements of these 16 holes of regenerative soaking pits:

1. **Quality heating**
2. **Maximum capacity in available space**
3. **Utilization of low Btu fuel.**

Island type layout employing eight batteries of two holes each was used for this specially designed installation at a large eastern steel mill. Pit size: 16′ wide, 20′ long, 10′5″ deep. Each hole has individual cover mechanism.

Completely modern temperature and combustion controls insure rapid, efficient heating with a high degree of uniformity from top to bottom and complete absence of washing.

Pits are cross-fired and each pit has primary checkers at the base of the downtakes and also secondary checkers at the base of ejector type stacks. The checker system preheats combustion air to approximately 2000°F. Each pit has two induced draft stacks equipped with automatic reversal systems enabling each hole to handle 35,000,000 Btu per hr. input of 106 Btu per cu. ft. mixed coke oven and blast furnace gas. Fuel rate for heating 3½ hr. track time steel is approximately 500,000 Btu per ton and 1,100,000 Btu per ton when heating cold steel.

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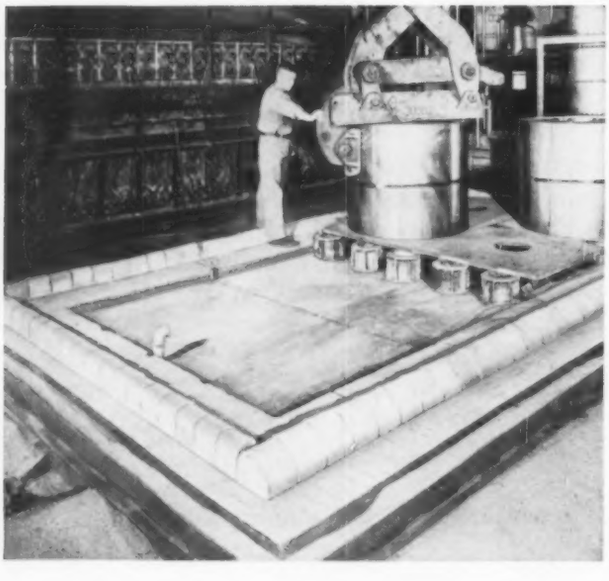
B&W Kaocrete-A resists CO disintegration and sand penetration at Granite City Steel



B&W Kaocrete-A is cast in the hearths and curbs of these furnaces where firebrick refractory was previously used.

Granite City Steel states that both bases have been in use for over three years without any disintegration resulting from the CO atmosphere. In addition, the monolithic structure of this B&W castable refractory eliminates the destructive effects produced by sand penetrating the joints and cracks of firebrick hearths.

For further information on B&W's specialized refractory castables, write for Bulletin R-35.

Strip annealing furnace with a capacity of 70 to 80 tons per charge on a 24 to 48 hr firing cycle, 48 to 96 hr cooling cycle, operating at a strip temperature of 1320 F in a 8.2% CO atmosphere. 4½″ lining of B&W Kaocrete-A is used on hearth and curbs.

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R-595

Figure 1 — The Ravenswood works is now in fully integrated operation, with the reduction plant (right) producing primary aluminum which the adjoining rolling mill (left) rolls to sheet, plate and foil. There are more than 60 acres under roof in the two plants.

Kaiser Starts Hot Rolling Mills at Ravenswood

THE $200,000,000 Ravenswood Works of Kaiser Aluminum & Chemical Corp. has become a fully integrated aluminum production and fabrication center on a 3000-acre site bordering the Ohio River.

The start of commercial operation of the quarter-mile-long "hot line" rolling facilities occurred on May 28. It is now possible to completely process the primary aluminum produced in the Ravenswood reduction plant to sheet, plate and foil in the adjoining rolling mill.

With more than 60 acres under roof, the Ravenswood Works currently employs approximately 1800 workers and is scheduled to mount to more than 2000 by September. When all the plant's scheduled auxiliary facilities are installed by 1960, employment is expected to total more than 4000.

Construction of the plant—perhaps the largest single industrial development ever undertaken in the state of West Virginia—is of great significance to the aluminum-using industries of the East and Midwest, to the Ohio Valley and to the coal industry, as well as to Kaiser Aluminum.

The Ravenswood Works has led in the new trend to create aluminum production facilities centered in the major market area for the metal, for within a 500-mile radius is 70 per cent of the nation's aluminum consumption.

Technological developments bringing greater economies to the generation of electrical energy by coal-fired steam plants have made it possible to build such an aluminum center in the Ohio Valley, rather than in areas close to hydroelectric power or near sources of natural gas.

For Kaiser Aluminum also, the move to the Ohio Valley has established a short, direct route for transportation of raw materials. Bauxite is mined by the corporation on the Island of Jamaica, shipped to facilities on the lower Mississippi River for processing to alumina, which is then transported directly to Ravenswood.

This direct-line material flow from mine to market center is expected to provide substantial operating economies and further strengthen Kaiser Aluminum's competitive position and ability to serve aluminum customers.

The Ravenswood Works has the most advanced and highly automated equipment devised for aluminum production, from the reduction of alumina to molten primary aluminum to the rolling of foil as thin as 0.0025 in.

The "hot line" includes three large rolling mills. First is a 168-in. reversing mill, largest in the aluminum industry, which breaks down

Figure 2 — One of the potrooms of the reduction plant. At periodic intervals, molten primary aluminum is tapped from the electrolytic cells into the crucible (foreground).

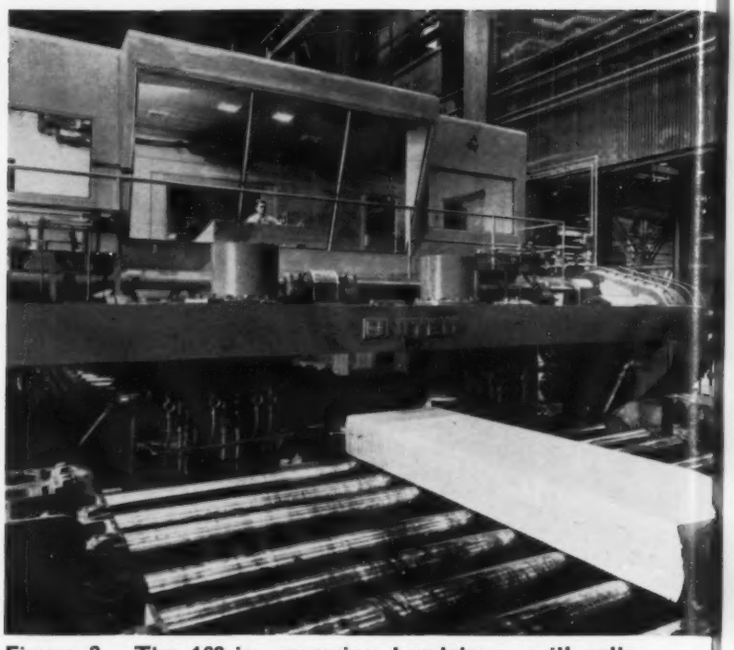


Figure 3 — The 168-in. reversing breakdown mill rolls 10,000-lb ingots like the one in the foreground to three-inch slabs.

10,000-lb ingots. Two 5000-hp motors are needed to power its rolls. Mill controls can roll finished aluminum plate 12 ft wide and 60 ft long.

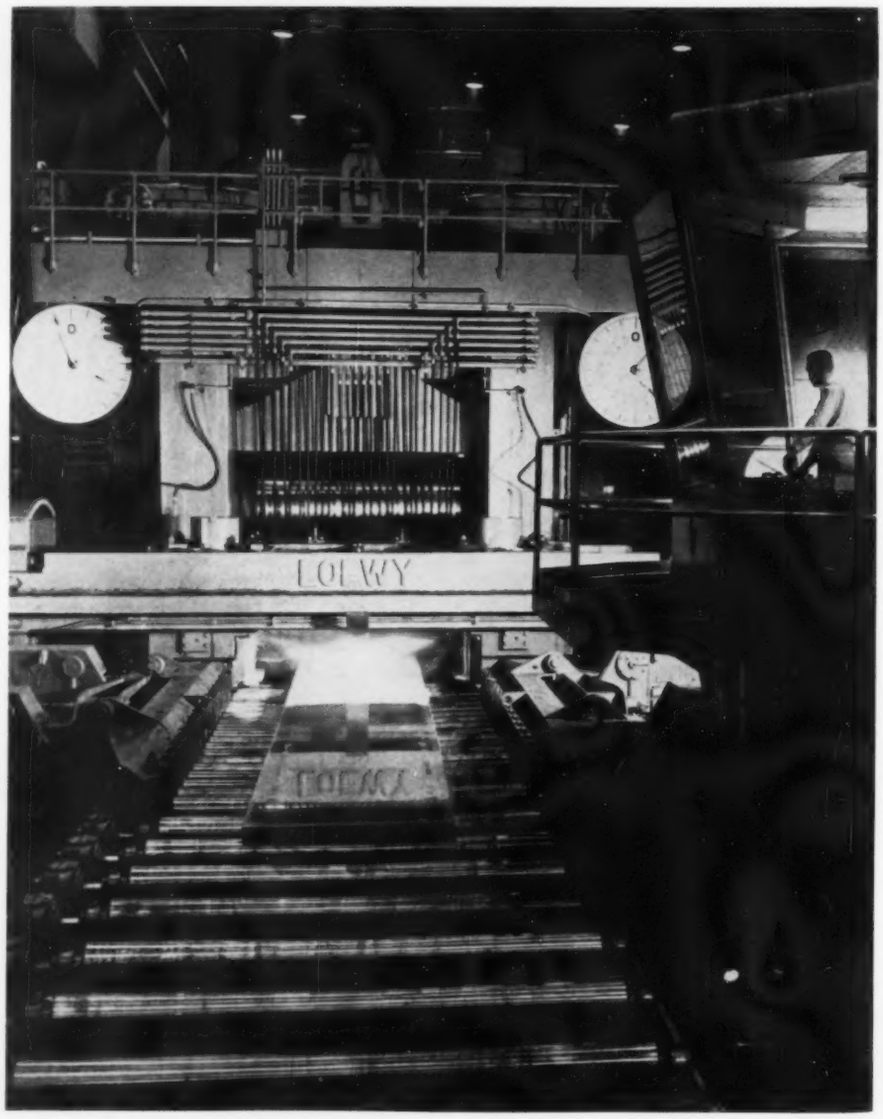
From the breakdown mill the aluminum moves next through a 110-in. reversing mill and then through a continuous 5-stand tandem mill. From this mill, the aluminum which started its journey down the hot line as an ingot 16 in. thick, emerges as hot-rolled coil perhaps a tenth of an inch thick at speeds up to 1250 fpm.

The coils from the plant's hot line subsequently are rolled down to the desired gages of sheet and foil in a succession of cold rolling mills, and given finish treatments to customer specifications.

Still to be installed at Ravenswood are additional cold rolling equipment for plate, sheet and foil, heat treating facilities and the world's largest plate stretcher. Upon its completion, the Ravenswood rolling mill will have an annual capacity of 170,000 tons of rolled aluminum products.

Two of the four potlines of the Ravenswood reduction plant are now in operation, with a current annual capacity of 72,500 tons of primary aluminum. Electrical energy for the Ravenswood Works is provided under a 40-year contract with the Ohio Power Co., a major operating subsidiary of the American Electric Power Co. ▲

Figure 4 — The 110-in. reversing mill is the second of the big rolling mills of the "hot line" of Kaiser Aluminum's Ravenswood works.



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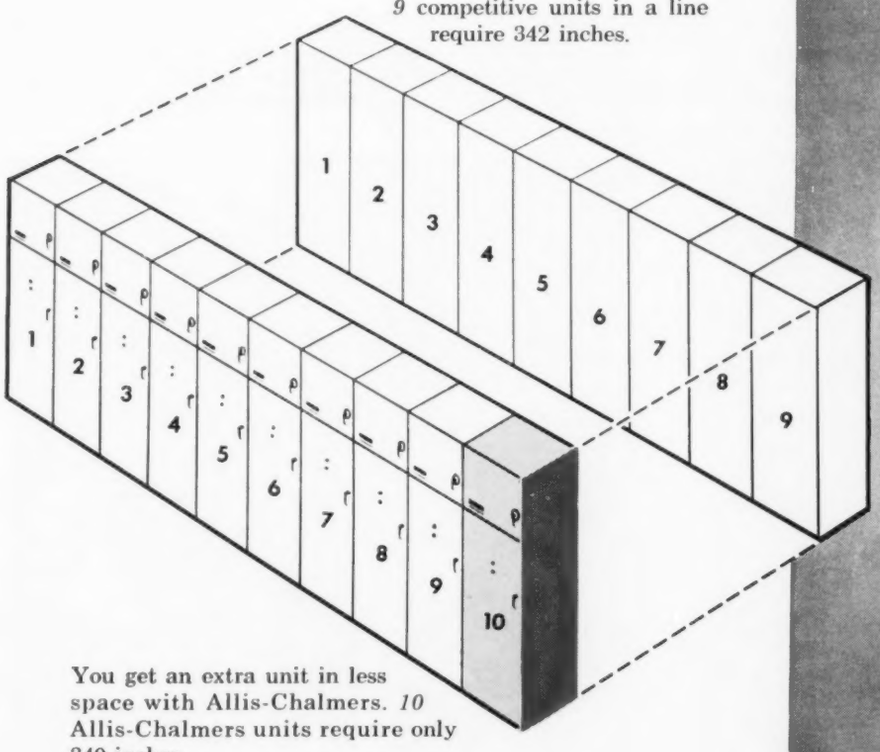
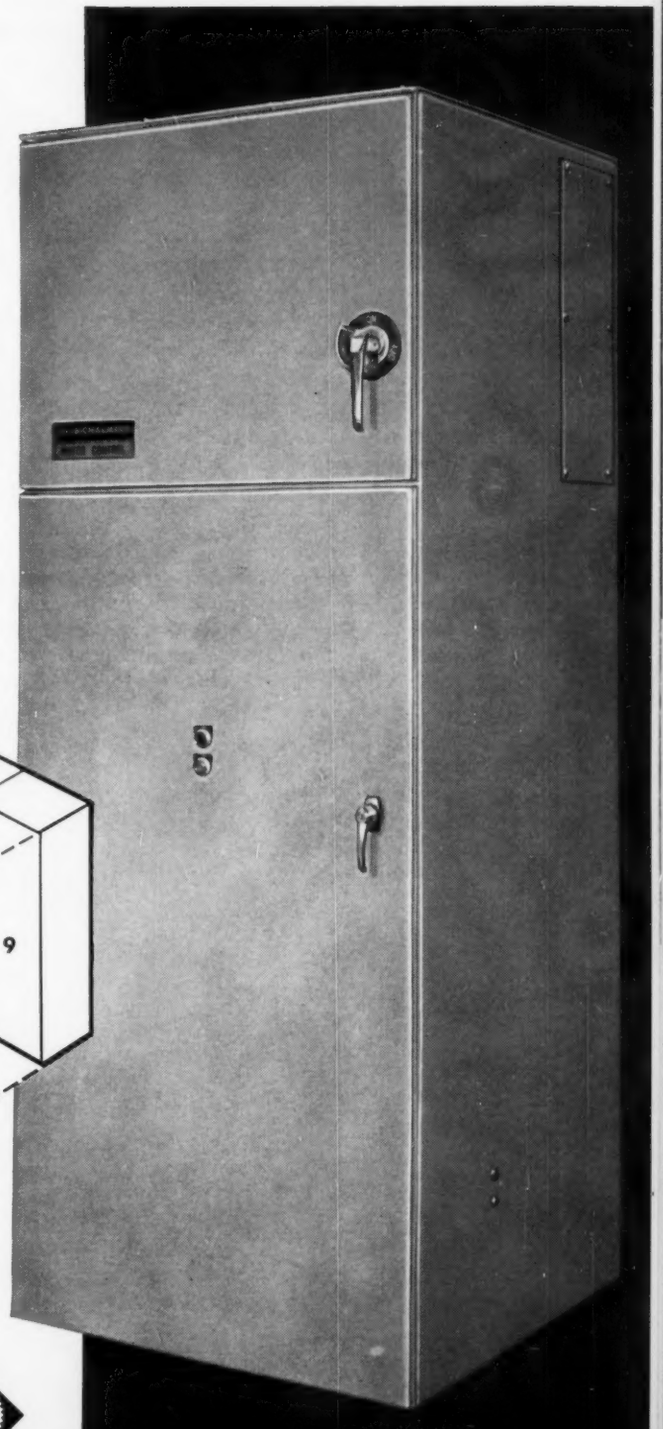
Smaller size is only one of many advantages in this new Allis-Chalmers design. You also get full-front access, more room for optional features, a completely tested unit, and the ultimate in protection for men and machines.

For more information on how this new control design can help you, call your nearest Allis-Chalmers representative, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

9 competitive units in a line require 342 inches.



You get an extra unit in less space with Allis-Chalmers. *10* Allis-Chalmers units require only 340 inches.



ALLIS-CHALMERS

A-5518

American Can Opens

THE world's first plant devoted exclusively to processing tin plate and steel plate from coils for the manufacture of metal cans has been opened in Hammond, Ind.

Built and operated by American Can Company's Canco division, the new plant has the capacity to process up to 600,000 tons of plate a year for shipment to Canco container plants in Indiana and Illinois. The plate traditionally has been shipped to can plants in sheet form directly from the steel mills.

The Hammond coil stock center is part of a long-range Canco program of technological development designed to produce containers of ever better quality at the lowest possible cost. Canco is spending about $31,000,000 on installing coil-processing equipment at Hammond and a number of other locations throughout the U. S.

The plant is equipped with nine shearing lines and a chemical-treating line, believed to be the only one of its kind in the world. The chemical line cleans and treats steel plate with a corrosion-resistant solution. The plate is then sheared for manufacture into containers for liquid detergents.

The plant will perform two basic functions—to chemically coat steel plate (black plate) for use in "tinless" cans and to shear huge coils of both tin plate and chemically treated plate into can making sheets up to 36 x 36 inches in size.

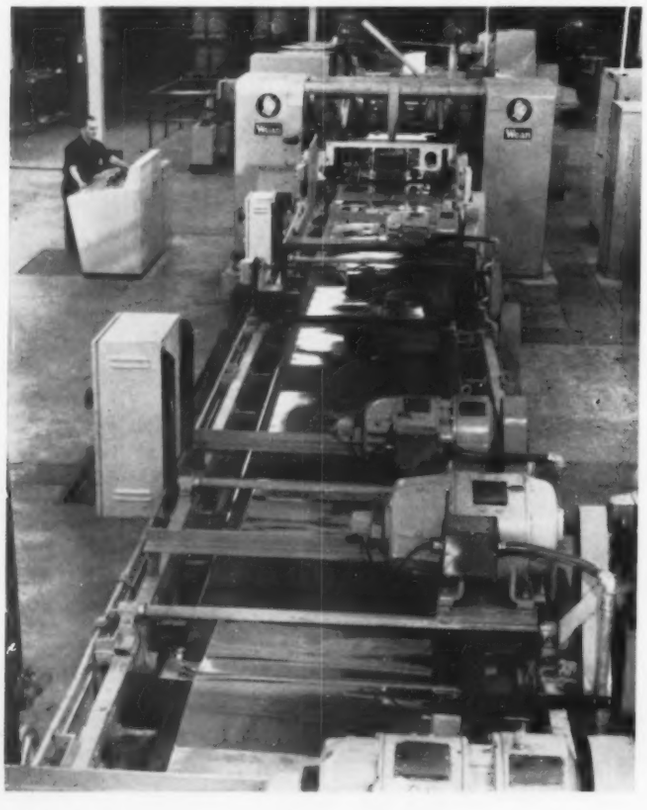
No containers of any kind are manufactured at this plant. Sheets produced at Hammond will be shipped to Canco can making plants in Illinois and Indiana. Chemically treated plate will be shipped to plants throughout the nation.

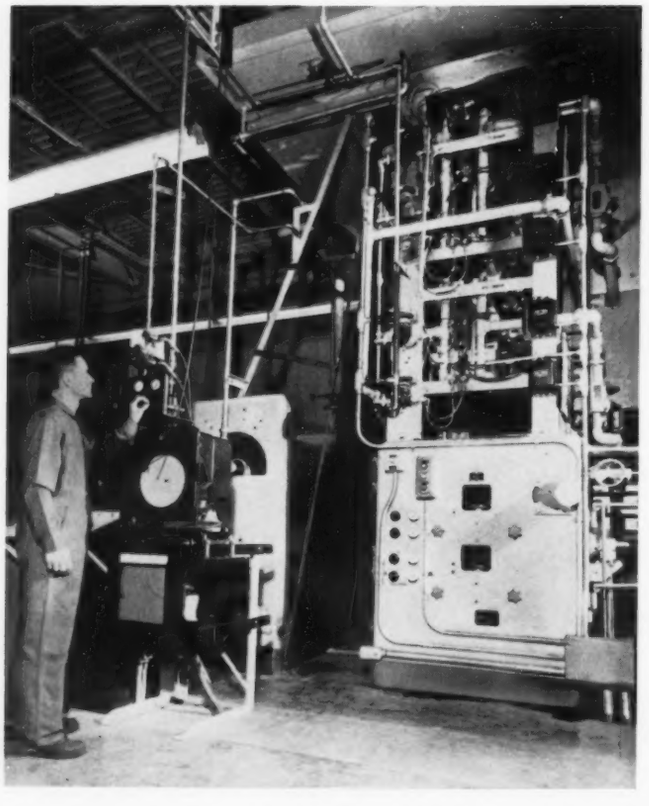
In order to carry out its jobs, the Hammond plant is equipped with eight Wean processing lines, each of which is capable of transforming 17,500-lb coils into precision-sheared sheets of can making plate; a chemical treating line; and a Littell processing line which shears the chemically treated plate and slightly smaller coils of tin plate than those placed on the Wean equipment.

The ultra-modern chemical treating line is a stride forward in the implementation of the company's program designed to develop tin-free can plate. Though most "tin-cans" contain only a small amount of tin, serious shortages nevertheless would result in the event of another war, since 75 per cent of the world's tin supplies lie in the shadow of Communist domination.

The chemical treating line is one of American Can Co.'s answers to

Figure 1 (left) — Sheets of precision-sheared can making plate roll off the end of a 100-ft coil shearing line at American Can Co.'s new Hammond, Ind., coil stock plant. Figure 2 (right) — Thoroughly cleaned steel plate is chemically treated in enclosed bath at bottom of this large vertical oven and then heated by burners which dry and cure the treated plate. Steel strip then passes through an air blast and under a water-cooled roll (left of oven) which cools the plate before it is rewound (left) on rewinding mandrel.





Coil Stock Plant in Hammond, Ind.

the problem. The line cleans and coats steel plate with a corrosion resistant chemical solution. Plate is then sheared and used in tinless cans for products such as liquid detergents.

Both tin plate and steel plate from Hammond-area steel mills are delivered palletized to the plant on flatbed trucks or on railroad gondola cars. The coils are unloaded by heavy duty overhead cranes. Specially designed heavy duty lift trucks move the coils into inventory.

After being unwrapped, a coil is moved by lift truck and placed on a roller conveyor which moves the coil in its horizontal, palletized position into an upender. The upender tilts the coil to a vertical position and places it on a coil carriage which hydraulically lifts and moves it into position on an uncoiling mandrel.

After being placed on the uncoiling mandrel, the coil strip is fed into the processing line where special tracking devices keep it in a straight line, a series of rollers removes the curvature of the coiled plate and an electronically maintained loop in the plate prevents drag on the plate as it enters the shearing machine.

As the plate travels along the 100-ft line electronic gages measure its thickness to tolerances of 0.001 in. The plate also is visually inspected for surface appearance and electronically inspected for pinholes.

An electronic "memory device" remembers signal impulses relating to imperfections in the coil strip and reacts by automatically sorting out substandard sheets after the plate has been sheared.

The plate is cut into sheets by high-speed flying shears and moved by conveyor belt through a classifier which automatically sorts and counts reject and prime sheet and ejects them into stacking boxes. Sheets recorded in memory devices as imperfect are automatically stacked as rejects. Prime plate is palletized and banded for shipment and then taken from the line by a lift truck which deposits the cut plate in inventory for later loading in trucks or railroad boxcars for shipment to Canco can making plants. ▲

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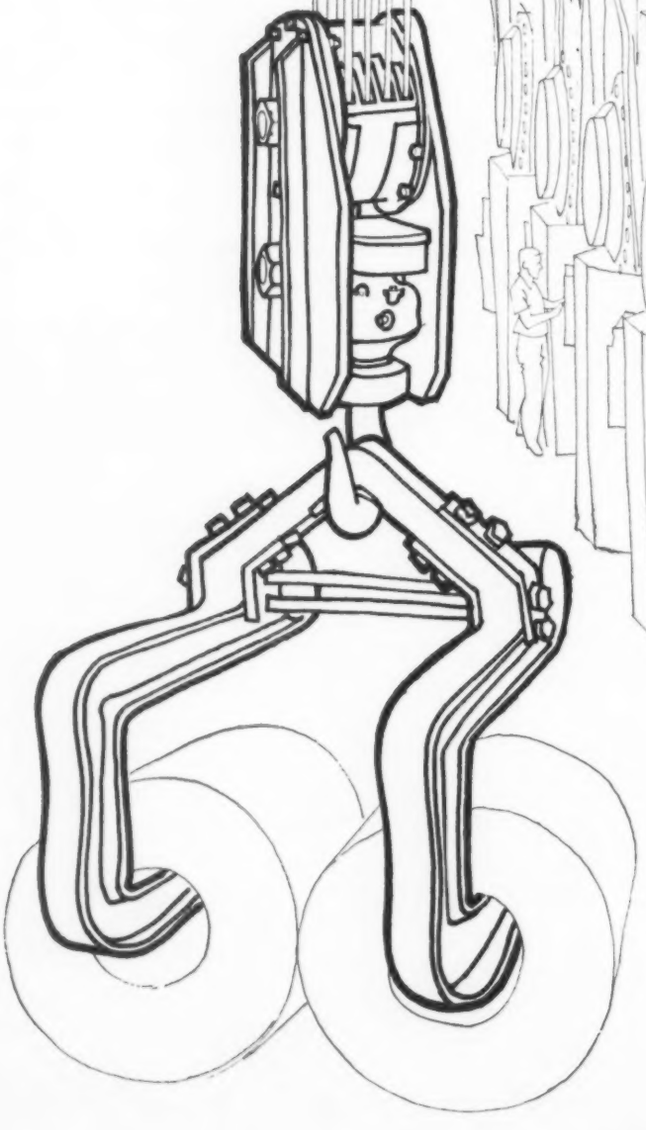
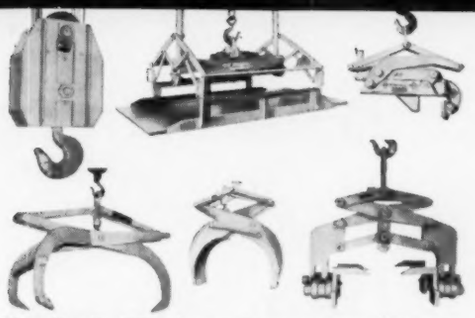


CUTS IT



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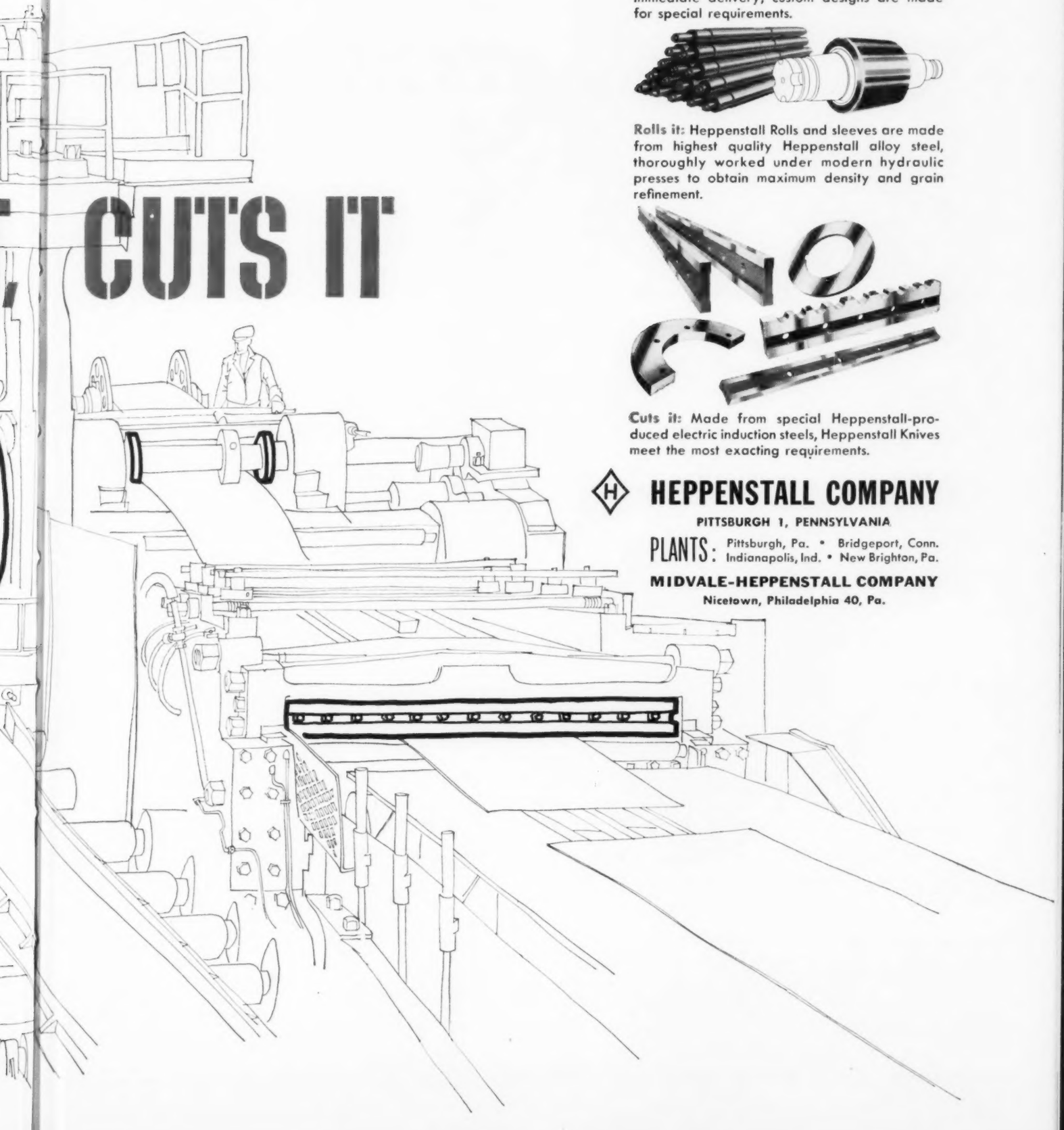

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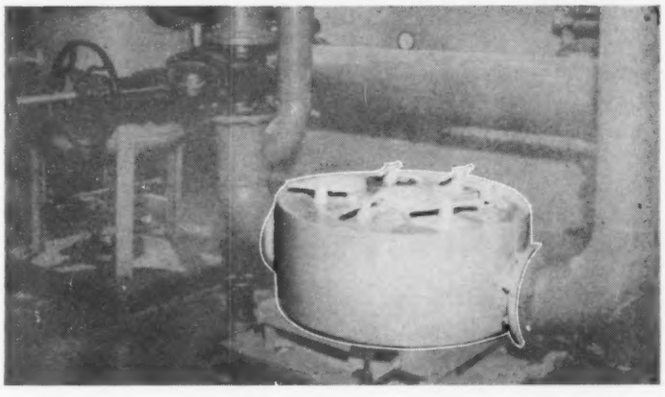

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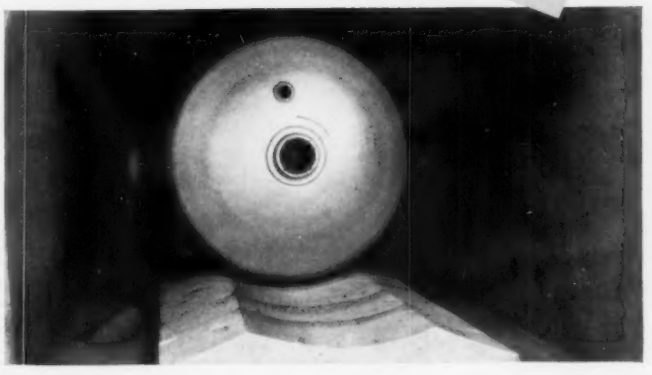

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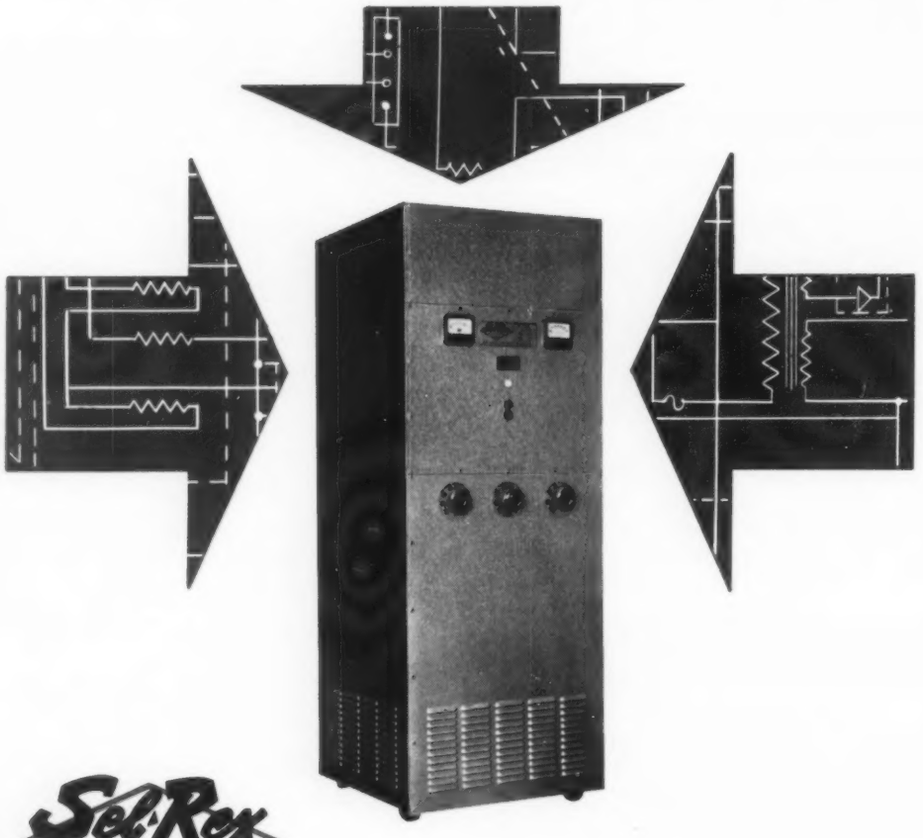

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Date-line Diary...

June 2

△ The AISI reports that the operating rate of the steel industry for the week of June 2 is scheduled at 1,641,000 tons. This compares with 1,567,000 tons one week ago (58.1 per cent of capacity) and 2,240,000 tons one year ago. Index of production for the week is 102.2.

△ The Aluminum Assn. reported that shipments of aluminum sheet and plate in April, 1958, totaled 103,382,000 lb, compared with 92,153,000 lb in March, 1958; shipments of aluminum foil in April, 1958 amounted to 15,444,562 lb, compared with 15,246,341 lb in March, 1958.

△ The Bureau of Mines, U. S. Department of the Interior, reported that production of iron ore in the United States for February, 1958, totaled 3,051,000 long tons; shipments 1,239,000 long tons; iron ore imported for consumption in the United States totaled 1,460,269 long tons.

△ The Bureau of Mines reported that in 1957 the United States produced 1,104,781 net tons of fuel briquets valued at $14,802,033 compared with 1,518,540 tons valued at $18,221,686 in 1956; packaged fuel produced in 1957 amounted to 47,287 net tons valued at $1,022,262 compared with 1956 production of 64,960 net tons valued at $1,381,880.

△ The Bureau of Mines reported consumption of scrap in the United States for 1957 amounted to 73,548,823 short tons compared with 80,315,170 in 1956; pig iron totaled 76,353,126 short tons in 1957 compared with 74,995,479 in 1956.

June 3

△ Prices on steel scrap advanced as much as $3 a ton in Pittsburgh and $5 in Chicago.

△ A joint announcement states that National Steel Corp. will buy Crown Cork & Seal Co. Inc.'s tin plate manufacturing equipment.

June 4

△ The Bureau of Statistics (Canada) reported that Canadian output of pig iron in May, 1958, totaled 288,553 tons, in April, 1958, 254,970 tons; ingot production in May, 1958, amounted to 402,752 tons, April, 1958, 367,573 tons.

△ Prices of copper were raised ¼¢ by custom smelters, to 24½¢ per lb.

△ Lead price dropped ½¢ to 11¢ per lb in New York.

△ The American Iron Ore Assn. reported shipments of iron ore down the Great Lakes through May 31, 1958 totaled 4,123,171 tons compared with 16,714,273 tons in the same period of 1957.

June 6

△ Government figures showed that construction outlays for May, 1958, rose seasonally to $4,100,000, up $400,000,000 over April, 1958.

June 9

△ The AISI reports that the operating rate of the steel industry for the week of June 9 is scheduled at 1,723,000 tons. This compares with 1,685,000 tons one week ago (62.4 per cent of capacity) and 2,214,000 tons one year ago. Index of production for the week is 107.3.

△ The Bureau of Mines reported that production of Pennsylvania anthracite for May, 1958, equalled 1,639,000 net tons compared with 1,571,000 tons in April, 1958, and 2,306,000 tons in May, 1957.

△ Great Lakes Steel Corp., subsidiary of National Steel Corp., announced discontinuance of $2 per ton differential in the base prices of steel products which it manufactured effective with shipments as of 12:01 A.M., June 10, 1958.

△ Business outlays for new plant and equipment fell to an annual rate of $32,400,000,000 for the first quarter of 1958, down $4,400,000,000 from the same period of 1957.

△ Labor Dept. reported that unemployment decreased to 4,904,000 in mid-May, down 216,000 from the April 15 level. Jobholders increased 1,154,000 in the month to May 15, totaling 64,061,000.

△ Custom smelters increased prices of copper ¼¢ per lb to 24¾¢.

June 10

△ Jones & Laughlin Steel Corp. plans to reopen its Cleveland Works the first week in July after being shut down in early February.

△ The AISI reported that steel production in May, 1958 totaled 6,308,000 net tons, compared with 5,532,991 tons in April, 1958, and 9,792,323 tons in May, 1957.

June 11

△ Lloyd D. Brace, president of the First National Bank of Boston predicted that electric utilities will have to spend about $40,000,000,000 for new construction by the end of 1965 which would be about $5,000,000,000 over the estimated book value of present private electric facilities. He forecast an increase in the nation's production of goods and services to around $550,000,000,000 by 1965, compared with $422,000,000,000 yearly rate in the first quarter of 1958.

June 12

△ The AISI reports estimated payroll for the iron and steel industry for April, 1958, amounted to $247,433,391, compared with $259,533,397 in March, 1958, and $316,602,348 in April, 1957. Estimated total employment was 502,653 compared with 512,328 in March. Average hourly payroll cost per wage earner was $3.108 compared with $3.092 in March, 1957, and $2.837 in April, 1957. Average hours worked a week was 33.1 compared with 33.6 in March.

△ Custom smelters increased price of copper 1¢ to 26¢ a lb; in London spot copper rose 1½¢ to 25¼¢ lb.

△ The Commerce Dept. reported an increase in personal income to a yearly pace of $344,300,000,000 in May, 1958, about $1,200,000,000 above the April level.

△ Steel scrap prices in Chicago declined $2 to $3 a ton. No. 1 was offered at $37 a ton.

June 13

△ The Labor Dept. reported that home building showed improvement with starts rising to a yearly rate of 1,010,000, up from 950,000 in April, and from 994,000 in May, 1957.

△ Rail freight loadings last week totaled 612,715 cars, 15.7 per cent above the preceding week, but 16.5 per cent below the like 1957 period.

△ McLouth Steel Corp. reduced price on hot rolled steel products $2 a ton.

June 16

△ The AISI reports that the operating rate of the steel industry for the week of June 16 is scheduled at 1,737,000 tons (64.4 per cent capacity). This compares with 1,728,000 tons one week ago (64.0 per cent capacity) and 2,181,000 tons one year ago. Index of production for the week is 108.1.

△ A Commerce Dept. report showed that world production of steel for the first quarter of 1958 dipped to an annual rate of 290,000,000 tons, compared with 322,000,000 net tons in 1957; output in the U. S., Canada, and Japan was lower; Russia, West Germany, France, Italy, Belgium, the Netherlands, and Luxembourg increased production; United Kingdom's output was about unchanged.

June 17

△ Anaconda Co. increased price for its copper to 26½¢ a lb, custom smelters also increased prices ½¢ to 26½¢ a lb level.

June 18

△ State authorities increased Texas crude oil production by one day to 9 days a month for July; permissible production for the month is 121,745 barrels daily above the current allowable.

June 19

△ The Aluminum Assn. reported primary aluminum production in the United States during May, 1958, was 129,083 short tons compared with 128,559 short tons in April, 1958, and 145,174 tons in May, 1957.

△ The ARCI reports that deliveries of new domestic freight cars in May, 1958, totaled 3534 compared with 5163 in April, 1958, and 8824 in May, 1957. Orders totaled 1372 compared with 278 in April, 1957, and 3370 in May, 1957. Backlog of cars on order as of June 1, 1958 stood at 30,386 compared with 32,908 a month earlier and 97,006 on June 1, 1957.

△ The Bureau of Mines reported that the consumption of scrap during April, 1958, totaled 3,429,000 gross tons, pig iron used was 3,378,000 gross tons; this compares with 3,718,132 tons of scrap and 3,824,140 tons of pig iron in March, 1958.

June 20

△ The Industrial Heating Equipment Assn. reports that new orders for industrial furnaces in May, 1958, were $953,000, compared with $3,572,000 in April, 1958, and $4,994,000 in May, 1958; orders for induction and dielectric heating equipment in May, 1958, were $501,000 compared with $949,000 in May, 1957.

June 23

△ The AISI reports that the operating rate of the steel industry for the week of June 23 is scheduled at 1,685,000 tons (62.4 per cent capacity). This compares with 1,751,000 tons (64.9 per cent of capacity) one week ago and 2,150,000 tons one year ago. Index of production for the week is 104.9.

△ New bookings of machine tools in May, 1958, totaled $21,900,000, off 4 per cent from April, 1958, and 47 per cent lower than in May, 1957.

June 24

△ Custom smelters lowered their charge for copper to 25½¢ per lb, down 1¢ from last week, following announcement of the stockpiling proposal aimed at taking 150,000 tons of domestic copper off the market.

June 25

△ The AISC reports that books of fabricated steel in May totaled 224,308 tons compared with 208,161 tons in April, 1958, and 331,227 tons in May, 1957; shipments in May, 1958, amounted to 328,180 tons compared with 323,574 tons in April, 1958, and 337,304 tons in May, 1957.

△ Shipments of iron and steel castings during April, 1958 amounted to 948,879 short tons compared with 953,509 tons in March, 1958, and 1,363,118 tons in April, 1957.

June 26

△ Inland Steel Co. announced a new employee stock purchase plan, starting August 1. A total of 500,000 shares are authorized to be offered by six month periods for up to ten years or until the authorized stock is gone at 90 per cent of the market price on the last day of each period.

△ The Aluminum Assn. reported that shipments of aluminum sheet and plate in May, 1958, totaled 102,953,000 lb, compared with 103,382,000 lb in April, 1958; shipments of aluminum foil in May, 1958, totaled 14,956,157 lb, compared with 15,444,562 lb in April, 1958.

△ Alan Wood Steel Co. announced steel price increases averaging $6 a ton, effective July 7, assertiny that wage increases due June 30 under the industrg contracts cannot be compensated for in any other way.

△ Roger M. Blough, chairman of U. S. Steel Corp. announced that the corporation's program of capital expenditures currently totals over $1,000,000,000, some $400,000,000 over the $640,000,000 of authorized projects for additions to and replacement of facilities reported May 31, 1958. The corporation plans to finance this expansion by offering $300,000,000 worth of 25-year sinking fund debentures to the public probably by July 16.

June 27

△ Effective August 1 the 3 per cent Federal excise tax on rail freight, the four-cents-a-ton tax on hauling coal and the 4½ per cent excise on oil transportation by pipelines will end. The 10 per cent tax on rail passenger travel will remain in effect.

△ National Coal Assn. predicted that production of soft coal this year will total about 420,000,000 tons compared with 490,000,000 tons in 1957.

△ Rail freight car loadings increased to 627,677 cars, 9 per cent above the prior week, but 15.9 per cent below the same period in 1957.

△ The trustees of Northeastern Steel Corp., under a plan of reorganization, have been authorized by U.S. District Court for Connecticut to distribute common shares of Carpenter Steel Co. in exchange for Series A and B 6 per cent subordinated debentures of Northeastern, at the rate of one share of Carpenter common stock for each $200 of face value of debentures.

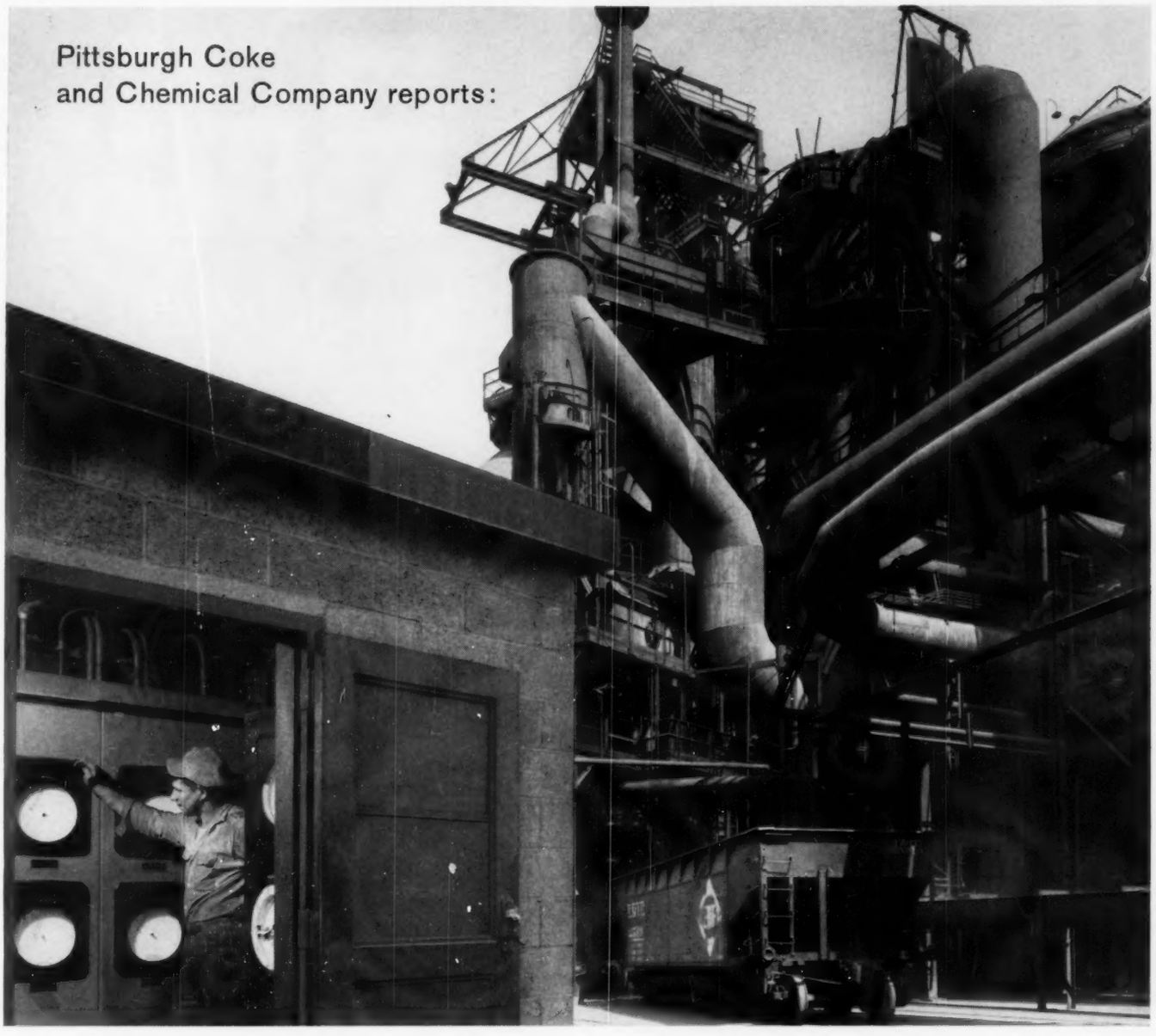
June 30

△ F. W. Dodge Corp. reported construction contracts in the U.S. in May totaled $3,402,575,000, the highest figure ever reported for any single month, and a small fraction of one per cent over the record set in May, 1957.

△ Workers getting unemployment compensation totaled 2,704,600, down 113,000 from the previous week, and is the lowest this year.

△ The AISI reports that the operating rate of the steel industry for the week of June 30 is scheduled at 1,423,000 tons (52.7 per cent of capacity). This compares with 1,666,000 tons one week ago (61.7 per cent capacity) and 2,009,000 tons one year ago. Index of production for the week is 88.6.

△ The Commerce Dept. reported that manufacturers sales in May, 1958 totaled $25,100,000,000, an increase of $200,000,000 over April, 1958 on a seasonally adjusted basis.



FASTER STOVE RECOVERY...
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with Foxboro Complete Blast Furnace Control

"Faster return to the control point after we change stoves," is just one of the things that Pittsburgh Coke and Chemical says about their Foxboro Blast Furnace Control System. Installed on a giant Merchant Furnace and Gas Washer, this system records and controls over 40 important variables.

Foxboro instrumentation makes furnace operation easier... permits automatic control from a centrally-located panel. And since *all* measurements are recorded on convenient circular charts, the Plant Superintendent finds it easier to supervise over-all furnace operation, too.

Pittsburgh Coke and Chemical's system uses both electronic and pneumatic instruments. Electronic recording gives fast, sensitive measurement of temperatures, pressures, and flows, while pneumatic control provides the smooth proportional control necessary for precise valve action.

As for maintenance, they report practically no interruption in service since their Foxboro control system was installed in 1952. Find out how Foxboro can improve blast furnace performance in your plant. Write for special data on blast furnace instrumentation. **The Foxboro Company, 587 Neponset, Foxboro, Mass.**

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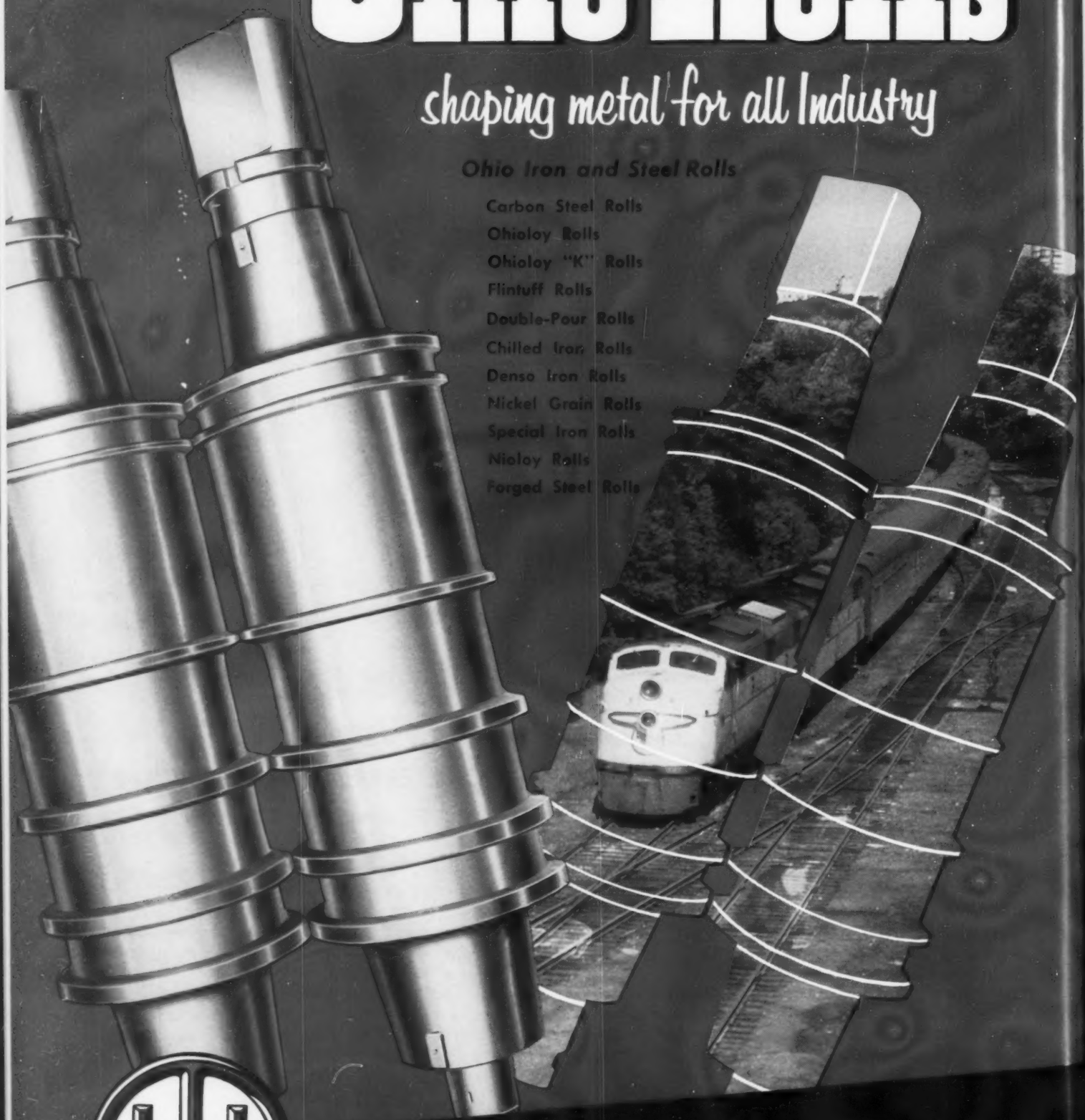

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Industry News...

KAISER STEEL CORP.'S NEW TIN PLATE FACILITIES NOW IN OPERATION AT FONTANA, CALIF.

△ New facilities designed to increase tin plate production by 85 per cent at Kaiser Steel Corp.'s Fontana, Calif., plant went into operation May 16.

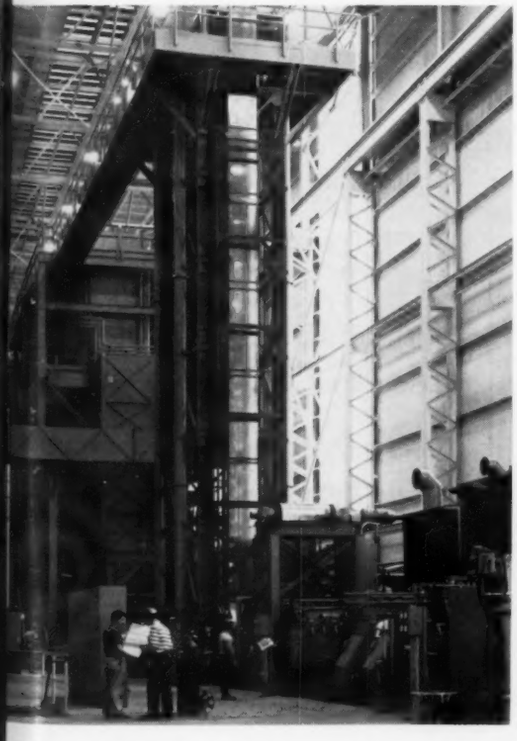
The Tin Mill additions are the first major facilities to be completed in Kaiser Steel's $214,000,000 expansion program now under construction.

The facilities, incorporating the latest technological advances in the industry, constitute a complete new electrolytic tinning line at Fontana, increasing Kaiser Steel's tin plate capacity from 200,000 tons per year to 370,000 tons per year.

More than 350,000 sq ft of floor space have been added to the existing mill to house four major units for the production of electrolytic tin plate. These units include a new pickling line, a new continuous annealer, a new temper mill and a new electrolytic tinning line. The new mill also includes a coil preparation line and increased storage, warehouse and shipping facilities.

All phases of Kaiser Steel's major expansion will be completed this year. Design and construction are being handled by Kaiser Engineers. Included in the program are three oxygen process furnaces, a fourth blast furnace, ninety new coke ovens a new hot strip mill, a universal slabbing mill and expansion of the plate mill. Over-all expansion will virtually double Kaiser Steel's capacity from 1,536,000 ingot tons per year to 2,933,000 ingot tons per year.

The West's first continuous annealer is shown in operation at Kaiser Steel's Fontana, Calif., plant. The unit is one of the major installations in the expansion of the Tin Mill which increases Kaiser Steel's tin plate production by 85 per cent to 370,000 tons annually.



J&L UTILIZES ANALOG COMPUTER IN RESEARCH

△ Jones & Laughlin Steel Corp. has installed an analog computer, which facilitates extensive research and controlled experiments in the various steelmaking processes without unreasonable expenditure of time and money. J&L is the first in the steel industry to purchase such a computer.

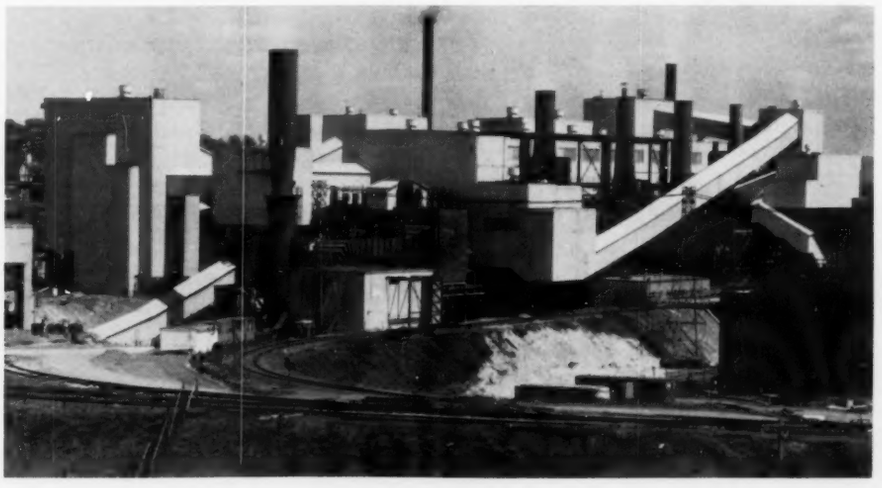
The computer, designed and constructed by Electronic Associates Inc., is located in the Instrumentation Section at the Graham Laboratory for J&L Research in Pittsburgh. Its activities are directed by the corporation's Research and Development Department.

The analog computer, which has been referred to as an "advanced slide rule," is a highly accurate device which permits engineering and research personnel to simulate complex metallurgical and mechanical processes electronically, and save many hours of involved calculation.

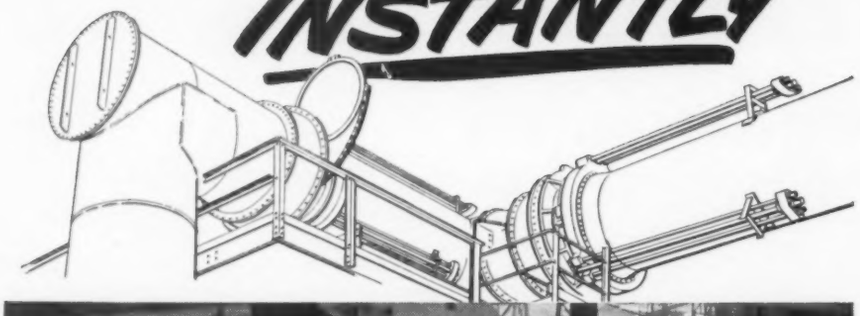
For example, to determine what happens in a metallurgical process where certain factors, such as time and temperature, may be changed for more efficient results, the older method was to build a pilot model, or a full-scale plant, and methodically make all of the changes and

NEW SINTERING PLANT COMPLETED AT YOUNGSTOWN

This is a general view of the new sintering plant recently completed at United States Steel Corp.'s Youngstown District Works. Designed and built by the Dwight-Lloyd Div. of McDowell Co., Inc., the plant will produce up to 6000 tons of sinter daily. The sintering machine is 202 ft over-all length and 8 ft wide. With 21 windboxes, an active hearth area of 1344 sq ft is provided. The hearth travels at speeds up to 24 fpm and will take a maximum bed depth of 18 in. A 390,000-cfm, 35-in. suction fan is used. Sinter is transferred over a vibrating screen conveyor to a 235-ft cooling conveyor, and then passes to doubledeck shaker screens. Charge material is mixed in "flying saucers." The new plant is controlled from a central board designed to keep the operator completely informed as to product flow and plant operation at all times.



HOW TO CLOSE LARGE GAS MAINS INSTANTLY



Bailey ENGINEERS

THERMAL EXPANSION GOGGLE VALVES

Bailey Mechanical Goggle Valves are produced in diameters from 6" to 72".

A powerful, completely dependable force of nature—the linear expansion and contraction of steel—is used to open and close gas mains equipped with these valves. When steam is applied to three sets of tubes they expand to separate the flanges, thereby freeing goggle plate for swinging to open or closed position.

Designed to protect men and equipment, Bailey Goggle Valves are safe and efficient on gas washers, blast furnace mains, precipitators and boiler plants. Diameters range from 36" to 120".

WILLIAM M. Bailey COMPANY
ENGINEERS
LEADERSHIP THROUGH QUALITY
1221 BANKSVILLE ROAD PITTSBURGH 16, PA

combinations of changes one at a time.

This also can be accomplished through mathematics, but the computations are so complex that a mathematician might work years in reaching a solution.

The analog computer is a combination of both methods. It serves as a scale model bridging the gap between the mathematical symbols and physical processes. In the simulation of a process, the computer is considered as a miniature plant and is operated exactly like its counterpart, without the limitations of time and expense.

The computer can rapidly change the variable factors through thousands of possible combinations in a few hours. By doing this, it can give an answer, in graph form, to any required combination of factors involved. Extreme conditions in an operation which might cause serious upsets in production, yieid or quality can be tried on the computer without any of these difficulties.

Data from the actual process are used in establishing the model on the computer. When the computer model behaves the same as the actual process, accurate studies of different effects on the process may then be performed on the computer.

Initially, J&L is using the computer for the improvement of process control, analysis of automatic control systems, and in the study of information-handling methods to improve data-collection techniques.

The analog computer solves the entire problem simultaneously in the exact manner indicated by the mathematical equations. There is no delay while large amounts of numerical data are converted into an understandable form. Related curves are drawn as fast as computation of the problem takes place. When the problem has been solved, an accurate pen and ink graph appears on the plotting board ready for study and evaluation.

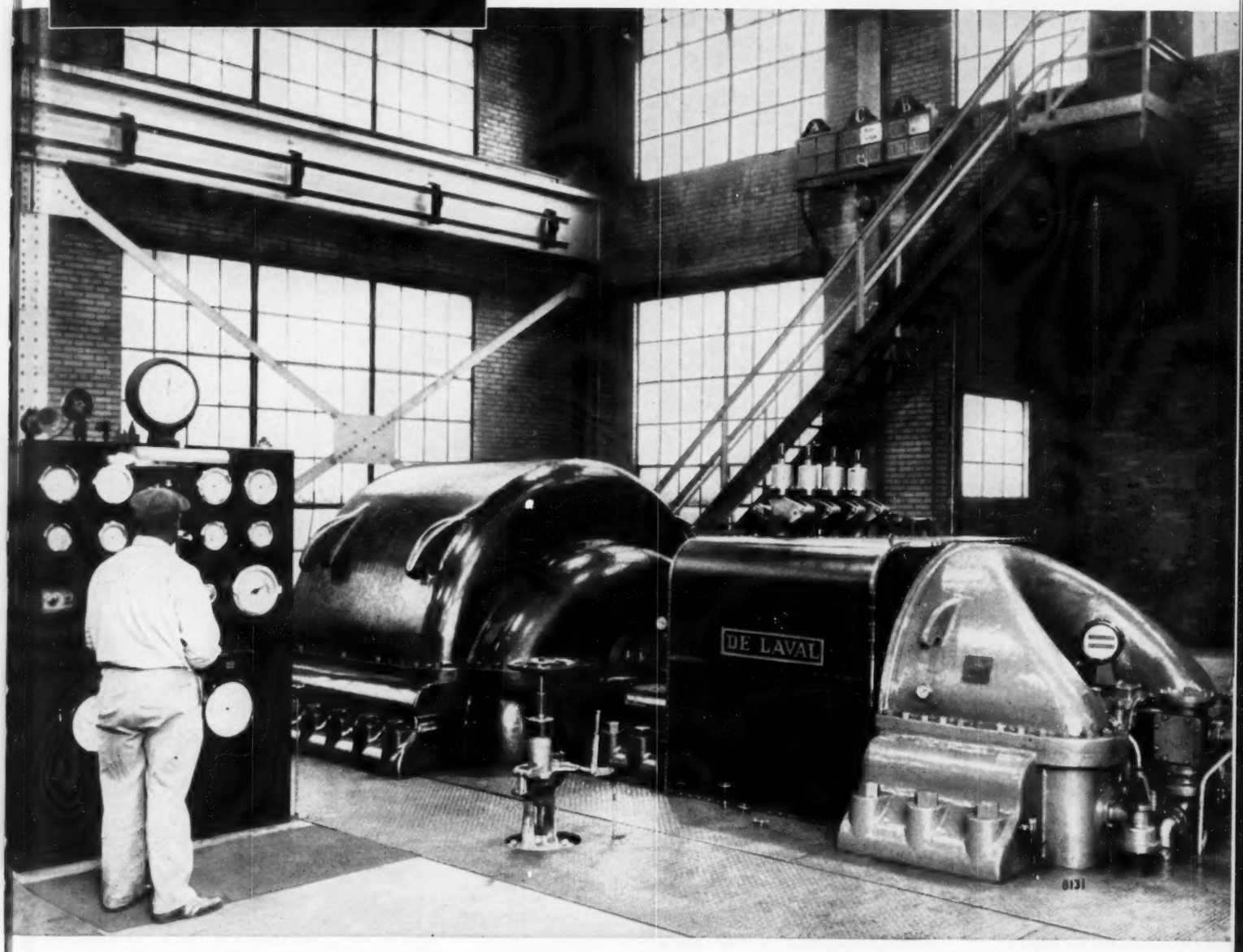
NEW HOT STRIP MILL OPERATING AT BUTLER

△ Armco Steel Corp.'s 56-in. hot strip mill began production June 3 at the Butler Works.

The new $26,000,000 mill will enable the Butler plant to hot roll wider sheets of Armco's precipitation hardening grades of stainless

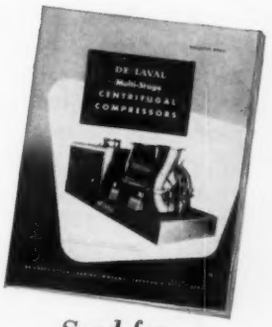
DE LAVAL
BLAST FURNACE BLOWERS

give 20 years of service at Great Lakes Steel Corp.



Shown is one of two De Laval centrifugal blast furnace blowers at the Ecorse, Michigan, plant of the Great Lakes Steel Corporation, Division of National Steel Corporation. This 85,000 cfm unit was installed twenty years ago; another 75,000 cfm unit went on the line a year earlier. Both have given dependable round-the-clock service ever since. These turbine-driven blowers are hooked up to a multi-head which enables either one to be used in conjunction with any of the three blast furnaces.

De Laval centrifugal blowers are built in single and multi-stage types to supply air in volumes up to 150,000 cfm for all classes of service in steel, gas and coke plants. The wealth of application experience acquired by De Laval over the years assures a correct and economical solution to your blower problem.



Send for Bulletin 0504

DE LAVAL *Centrifugal Blowers*

DE LAVAL STEAM TURBINE COMPANY
870 Nottingham Way, Trenton 2, New Jersey

steel. Electrical steels also will be produced by the mill which has 33,000 connected horsepower in seven electric motors.

It is the largest single project in the Butler works' current $80,000,000 expansion and improvement program. A number of other projects are yet to be completed. All will increase the plant's stainless and electrical steel production capacity.

Clyde G. Davies, vice president in charge of the company's Armco Div., said trial runs have shown that the new mill can roll a strip that is extremely uniform in thickness from end to end.

Davies pointed out that the new mill will replace one of the most famous production units in the steel industry—the old Butler strip mill.

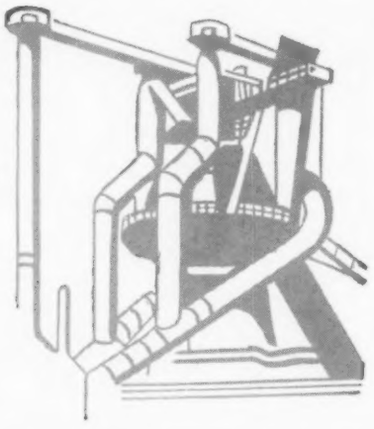
The annual rolling capacity of the new mill is double the rate of the old mill. Three new 80-ft long slab heating furnaces have been installed, which will more than double present heating capacity.

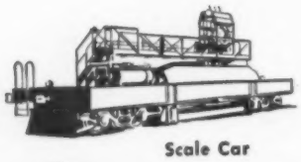
It can roll 52-in. wide material, delivering strip to the coiler at speeds up to 2000 fpm.

The strip will enter one of two new downcoilers which will handle a 16,000 to 17,000 lb coil, compared to the former coil size of 7000 to 13,000 lb. A new underground conveyor system will transfer newly rolled hot coils into a nearby area for stocking.

The new mill was designed and built by the Continental Foundry and Machine Div. of Blaw-Knox Co. Construction engineering was done by Patterson-Emerson-Comstock, under the general supervision of Armco's own engineering staff. Westinghouse Electric Corp. furnished the electrical equipment.

WHEREVER *performance* COUNTS





Scale Car

100-ton Ore Transfer Double Compartment, Bottom Dump

Coke Quenching Car

Atlas Cars are built to resist the high wear factors of continuous service handling abrasive materials. Extra factors of safety in brakes, controls, visibility, and signal devices are incorporated for foolproof service.

Each car is engineered to meet the operating needs of the plant where it will be used.

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Consult Atlas for your Steel Plant Cars

ENGINEERS AND MANUFACTURERS SINCE 1896

U. S. STEEL TO MARKET ALUMINUM COATED SHEET

△ A modification program at Irvin Works will precede U. S. Steel Corp's entrance into the aluminum coated steel sheet market, according to an announcement by Richard F. Sentner, U. S. Steel's executive vice president—commercial.

Engineering plans call for alteration of the 48-in., light gage continuous hot dip galvanizing line at Irvin works to also produce aluminum coated steel sheets.

The modified coating line will produce aluminum coated steel sheets 18 gage and lighter. Principal applications of the new product are expected to be in the automotive, aircraft, farm and home appliance fields.

The product will combine the inherent strength of carbon steel with aluminum's resistance to atmospheric corrosion, good heat reflectivity and heat resistance. Aluminum as a steel coating has high temperature advantages over zinc.

Decision to modify facilities to produce aluminum coated sheets came after a study of customer needs and product applications. The new product, after thorough testing of the modified facility, will join U. S. Steel's established line of sheet and strip products late in 1959.

GE RECEIVES ORDER FOR BRAZILIAN MILL

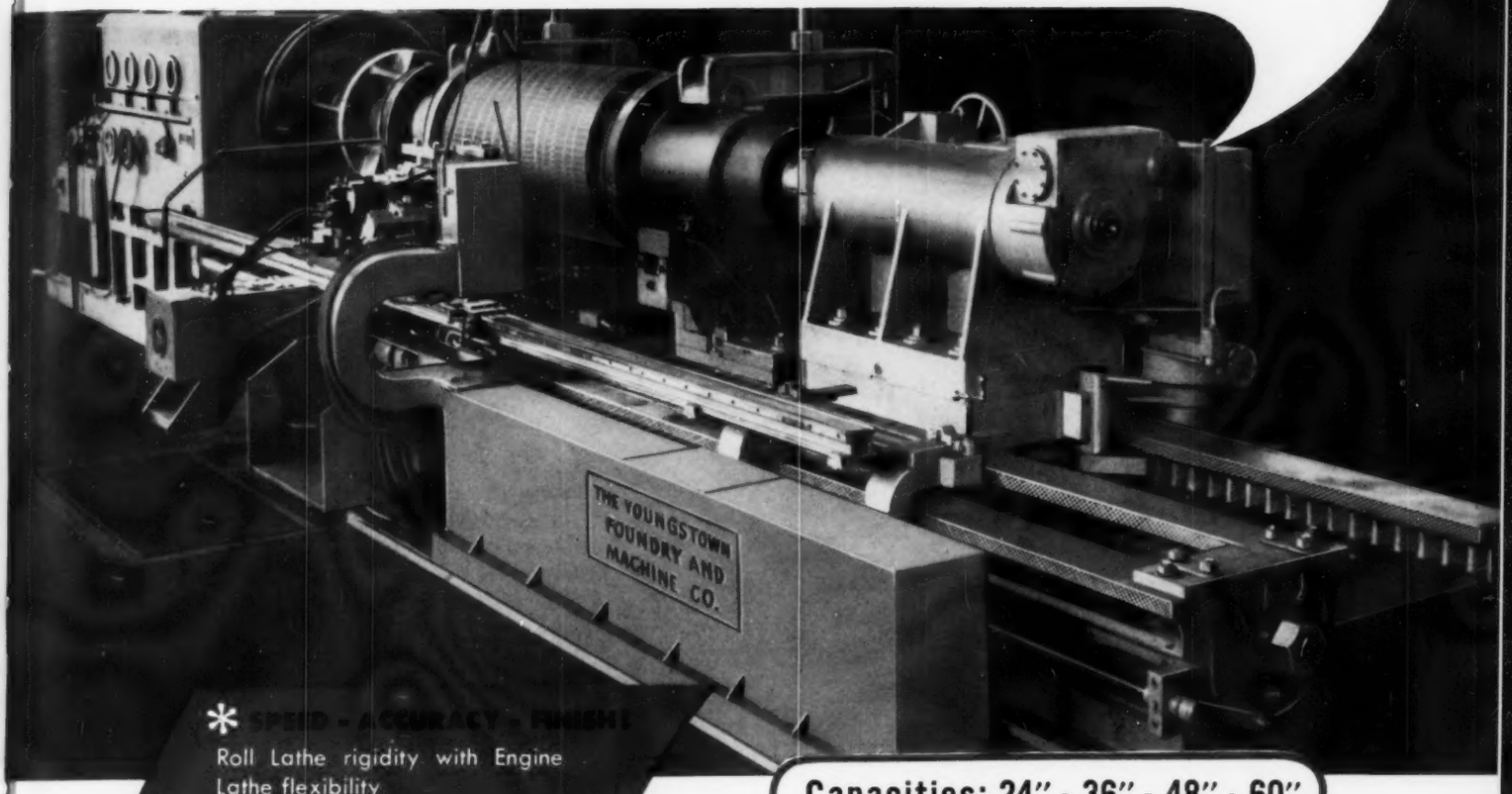
A $2,000,000 order to supply the complete electrical system for a new steel rolling mill in South America was announced by General Electric Co.

Electrical equipment will be prepared for shipment to Brazilian

(*Please turn to page 159*)

tomorrow's design in today's

Now "YOUNGSTOWN" Contour Roll Lathes*



* Roll Lathe rigidity with Engine Lathe flexibility

Capacities: 24" - 36" - 48" - 60"

* controlled automatically. Front mounted tracer and templet for operating ease and faster set-up

* Faceplate supported by extra large Timken roller bearings mounted on extra large torque hub to carry heavy radial and thrust loads

* designed for either single point carbide-tipped tools or regular roll turning tools

* Herringbone gearing; automatic lubrication; illuminated inspection ports

Turn rolls better and faster with Automatic Tracer Control

Far ahead in design and efficiency, this new roll lathe has been developed to turn rolls better and faster . . . either on necks or centers . . . from the smallest bar mill roll to the largest back-up roll. Tested and proved in our own roll shop. Capacities to meet your specific needs.

The 48" roll lathe pictured has a speed range of 1.40 RPM to 81.1 RPM. Roll capacities: 18" minimum diameter, 50" maximum diameter, with 20'0" maximum length. Hydraulic ragging attachment can be furnished, as illustrated. Tell us your requirements . . .

Write for Complete Information

The Youngstown Foundry & Machine Company

Serving Industry Since 1885

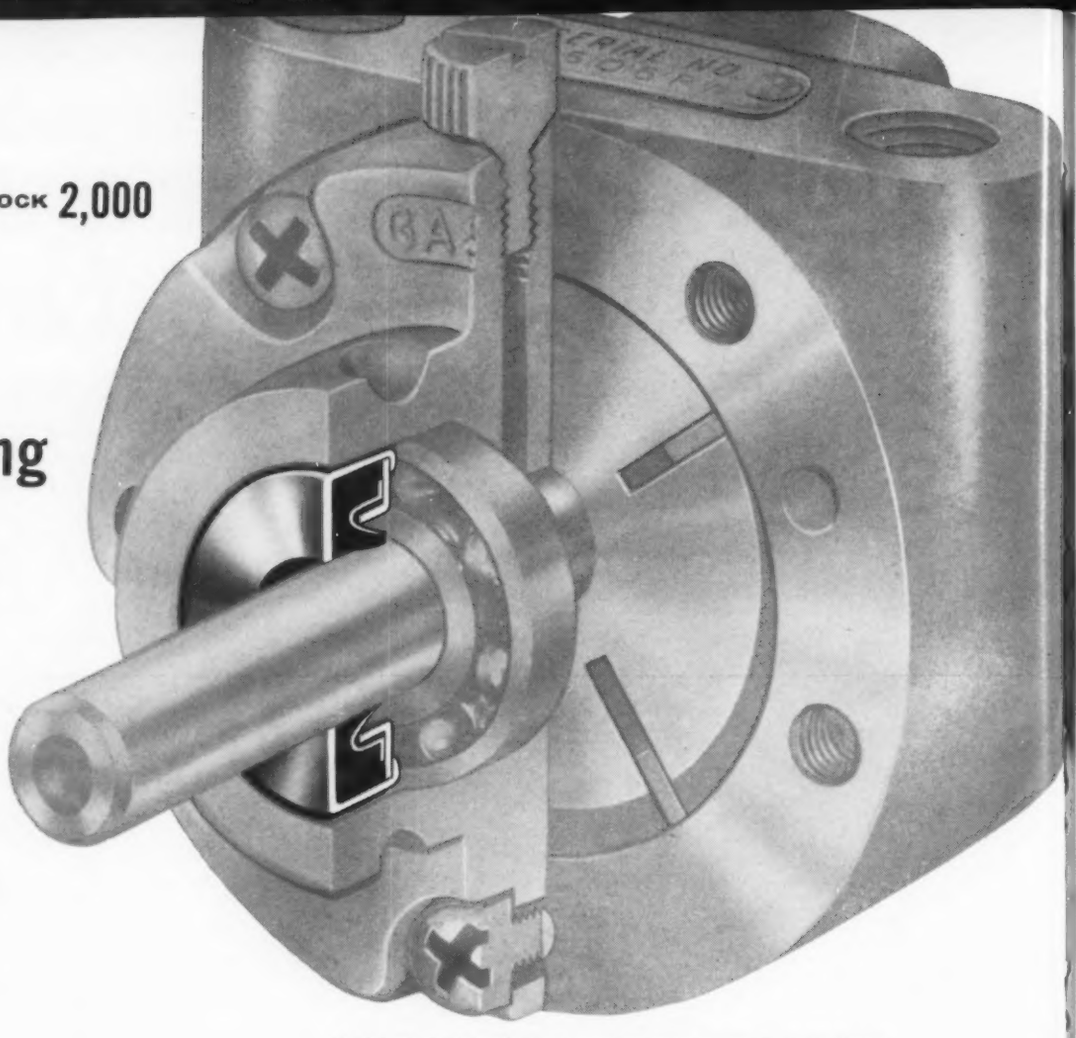
Youngstown 1, Ohio

HEAVY MACHINERY • AUXILIARY EQUIPMENT • CASTINGS • ROLLS

"YF&M" builds the best of them

MORE ABOUT THE GARLOCK **2,000**

Standardizing on Garlock KLOZURE* Oil Seals Pays Off for Gast



Model 51 Garlock KLOZURE protects bearing on Gast Air Motor made by Gast Manufacturing Corp., Benton Harbor, Mich.

Air motors require a long-life seal which will prevent leakage without creating excessive friction. That's one reason why Gast Mfg. Corp. use Garlock KLOZURE Oil Seals on both their Air Motors and Air Pumps. These products operate under pressures to 90 and 30 psi respectively, and at shaft speeds from 1000 to 5000 rpm.

Gast engineers report excellent results with Garlock Seals.—"They outlast some other parts of our products and are easily and economically replaced during major overhauls." Gast has standardized on Garlock KLOZURES for over 25 years—They like the compact design of KLOZURES, the wide availability of replacements, and the broad choice of sizes.

You can give *your* products the "seal of quality" too—specify Garlock KLOZURE Oil Seals . . . they are part of the famous Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals to meet all your needs. Consult your local Garlock Representative or write for KLOZURE Catalog 20. Other Garlock products are described in Sweet's Product Design File.

Other General Purpose KLOZURES

Model 53—for normal to high speeds

Model 718—for large shafts in normal to high speed service

Model 918—for small shafts in normal to high speed service

Model 65—for normal to high speeds

*Registered Trademark

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

THE GARLOCK PACKING COMPANY, Palmyra, N. Y.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

HOT METAL TRANSFER CARS FOR HOMESTEAD

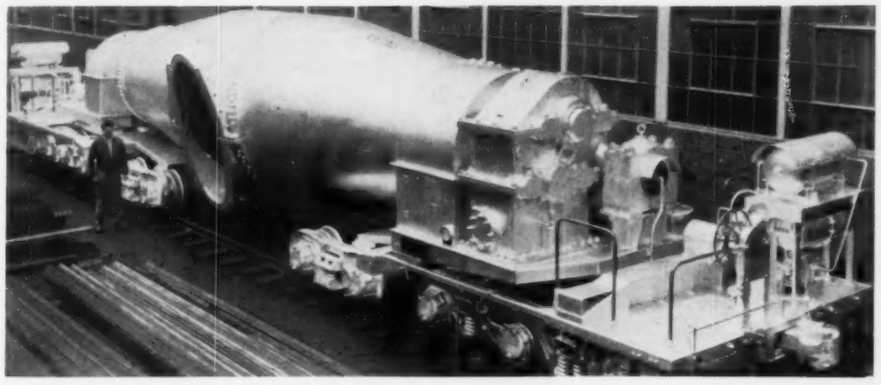
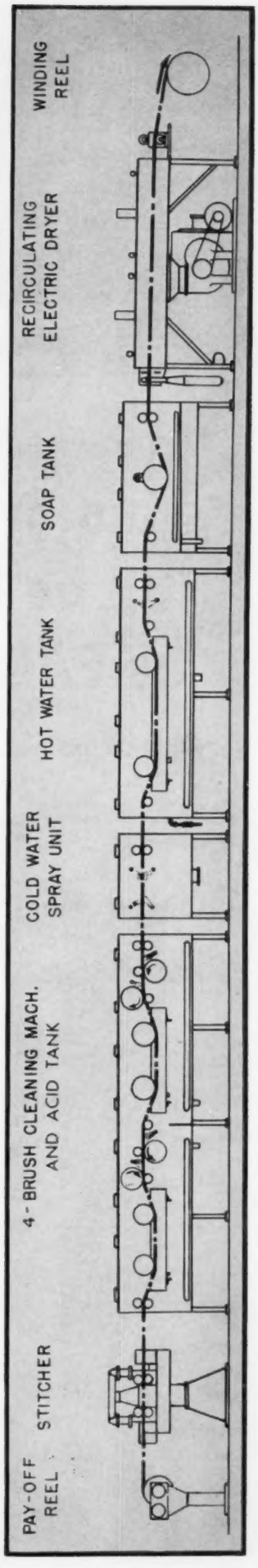


Illustration shows one of five modern welded 150-ton hot metal transfer cars being built for the Homestead works of the United States Steel Corp. by The William B. Pollock Co. This car has two sets of six-wheel trucks and two sets of four-wheel trucks. Over-all length, coupler to coupler, is 60 ft-0 in. and over-all height is 11 ft-7½ in. In order to reduce weight and meet existing bridge load limitations, the decks and spanner bolsters were redesigned for "T-1" steel plate construction. Savings were also made in the casting weights by the use of ductile iron. Weight savings total 66,000 lb of which 36,000 lb was due to engineering redesign, 24,000 to use of T-1 plate, and 6000 lb by using ductile iron. This car can be produced in sizes from 100 to 250 ton.

(*Continued from page 156*)

National Steel, Volta Redonda, where it will be installed in a new tandem cold strip mill—second major expansion of the plant within the past 5 years. A company spokesman said effort is being made to deliver the equipment in eight months —compared with a normal 12 to 13 months on a job of this magnitude.

COMPLETE STRIP CLEANING EQUIPMENT FOR YOUR SPECIFIC REQUIREMENTS



This is a layout of a typical Rockwell strip cleaning installation. A single machine or several units—all Rockwell custom-engineered—may be integrated in a continuous processing system to meet specific production requirements. Write for Bulletin 440 to W. S. Rockwell Company, 2428 Eliot Street, Fairfield, Conn.

15 ton stripper crane built by PACECO for the Columbia Geneva Division of U.S. Steel. This crane is designed for around the clock operation at the company's Torrance, California, plant.

Chances are 1 in 5

If it's bid by PACECO it'll be built by PACECO

Let PACECO Bid Your Next Mill Crane

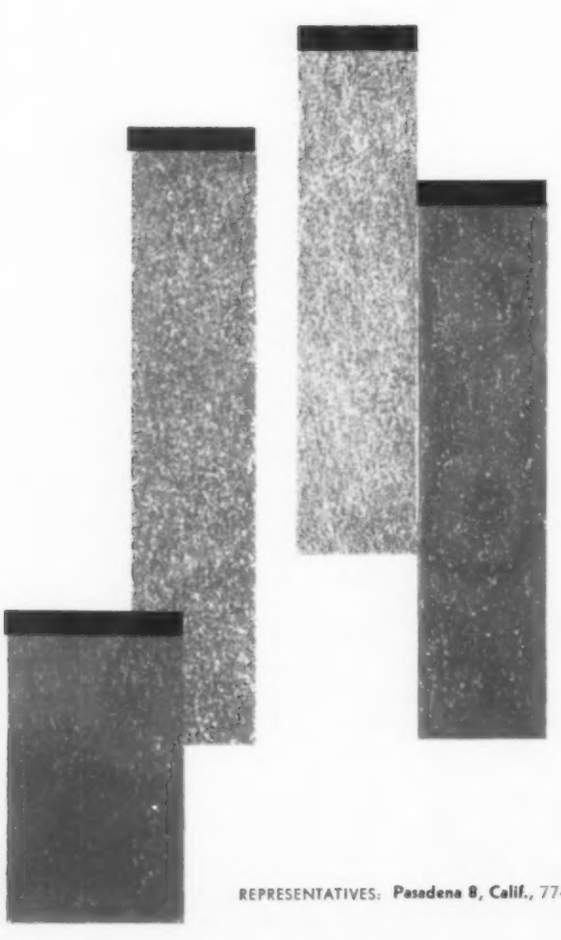
Put your specifications in the hands of experts, crane craftsmen who know how to cut costs without sacrificing performance... the result of 35 years of design-engineering-fabricating experience:

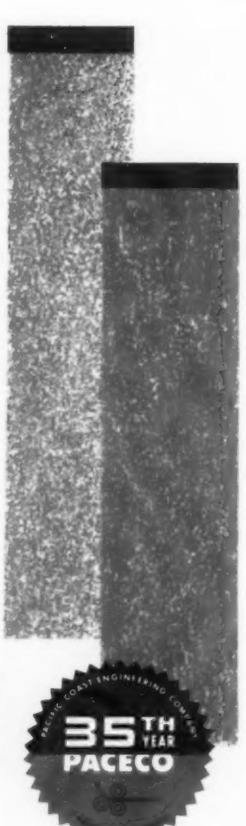
Proof: In 1957 PACECO was awarded over 20% of the amount of crane work bid!

PACECO will build cranes to AISE or customer specifications. Or they will consult with you on your special needs; then custom design and build. Call your nearest PACECO office, or representative today for consultation or estimate.

DUAL TORQUE* AND FLOAT CONTROL are new concepts in crane control by PACECO. These developments cut costs, increase crane efficiency. For more information write for brochure 7-D or contact your nearest PACECO office or representative.

*PATENT APPLIED FOR





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Alameda, California • **New York 17, N. Y.**
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51 East 42nd St. OXford 7-1475

REPRESENTATIVES: **Pasadena 8, Calif.**, 774 East Green St., RYan 1-6663 • **Houston 1, Texas**, P. O. Box 1035, MOhawk 4-3504

4803

(*Continued from page 159*)

The entire Volta Redonda plant, near Rio de Janiero, produces about one million tons of steel a year—making it the largest steel center in South America.

Basic electrical equipment for the plant's hot strip, cold strip and structural mills was furnished by GE in 1942 and installed in 1945. In the facility's first expansion, 1951 to 1955, GE provided additional equipment for these mills and for some of the plant's smaller mills.

Equipment for the new mill consists principally of motors, generators and controls for three stands and a fourth future stand—for a total of 15,500 hp in the main drive system.

Maximum strip speed with three stands will be 2610 fpm, or 3160 fpm with the fourth stand. Maximum strip width will be 48 in.

PLANT EXPANSION ANNOUNCED BY UNITED

△ A $1,750,000 expansion program at its Vandergrift, Pa., plant has been announced by the United Engineering and Foundry Co. The expansion will encompass extensions to both casting and steel roll finishing buildings.

The casting building extension will provide space for a 32-ft wide x 60-ft long x 30-ft deep roll casting pit together with a large roll mold drying oven and space for roll molding operations. The roll finishing building extension will house two new large roll heat-treating furnaces, one 72-in. and one 60-in. roll lathe, one 75-ton capacity overhead traveling crane, and a storage area for rolls in process.

SKF BEGINS EXPANSION PROGRAM AT MASSILLON

△ A more than $1 million expansion and improvement program—the first phase of a long-range expansion project—has begun at the Tyson Bearing Co. plant, Massillon, Ohio, a division of SKF Industries, Inc.

The initial phase of the expansion, providing about $1,200,000 for new equipment and new and improved construction, is expected to take four to five months to complete. It will add 18,000 sq ft to the plant's production areas, 2000 sq ft to office spaces, and involves removal of some existing buildings.

ACQUIRES RIGHTS TO BELLE FONS PROCESS

△ Salem-Brosius, Inc., has announced the acquisition of world rights to a new economical process for the reclamation of spent pickle liquor.

Under a license agreement with Pantech engineers of Oil City, Pa., Salem-Brosius will engineer, manufacture and sell the Belle Fons Process.

The Belle Fons technique regenerates spent acid and consists essentially of evaporation of water from spent acid, addition of fresh acid to crystallize the ferrous sulphate or suspended matter and the separation of the solids from the regenerated acid that is reused at great savings.

USE THE ENGINEERING MART

SAVE downtime for bearing replacement

use A·B·K* bearings

A-B-K bearings won't peen, score or heat check your heavy roll and spindle parts, sharply reduce downtime and maintenance costs per ton rolled. Made of laminated phenolic fabric, they have the ability to absorb and cushion heavier impacts—and often outwear metal bearings many times. When replacements *are* necessary, downtime is reduced because A-B-K bearings have fewer parts, are lighter in weight, easier to handle. Ask our engineers for specific recommendations.

- Wear longer
- Won't score
- Light in weight
- Cut lubricant costs
- Save power

A·B·K

LAMINATED PHENOLIC BEARINGS

A registered trade-mark of American Brake Shoe Compan

American Brake Shoe Company

AMERICAN BRAKEBLOK DIVISION

P. O. BOX 21, BIRMINGHAM, MICHIGAN

"No secondary cleaner required with a P-A Washer"

...says FURNACE SUPERINTENDENT

This economical feature of the Pease-Anthony washer is only one of the many reasons why P-A is first choice with blast furnacemen.

It's a "natural" where high top pressures are used . . . puts full top pressure to work cleaning gas . . . low water consumption . . . low initial cost with minimum maintenance requirements . . . compact design requires little space.

Units available for capacities ranging up to 150,000 SCFM. Write for descriptive bulletin.

Performance summary of some P-A Washers now in use:

Installation	Years Operated	Volume SCFM	Pressure Drop Inches Water	Dust Loading Grains/SCF	
				Inlet	Outlet
A	4	78,000	30	3-19.0	.01-.04
B	3½	78,000	30	2-3	.02-.08
C	3	85,000	30-40	2-3	.01-.03
D	3	45,000	30	2	.02-.03
E	½	75,000	50	—	.02
F*	½	26,000	12	5	.10
G*	½	26,000	12	5	.10
H	½	90,000	29	—	.04

Installation C is in Illinois. Installation H is in Texas. All others are in Pennsylvania.

*Two units in parallel on one furnace. Lower efficiency due to lower available top pressure.

CHEMICO

P-A GAS SCRUBBERS

CHEMICAL CONSTRUCTION CORPORATION

525 West 43rd Street, New York 36, New York
Telephone LOngacre 4-9400
Technical Representatives Throughout The World
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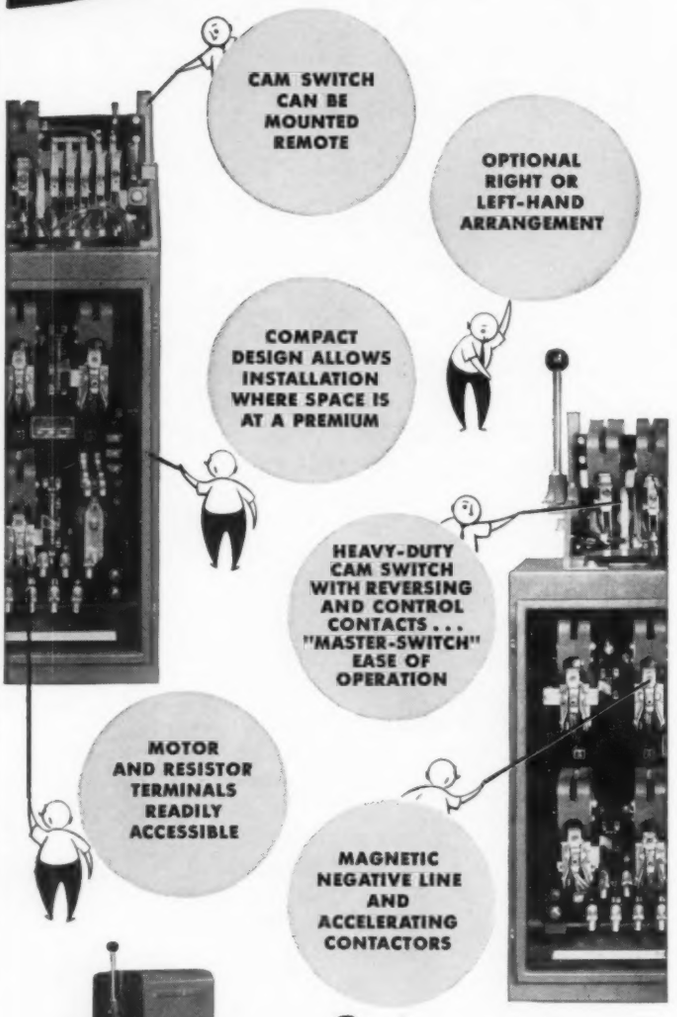
NEW HEAVY-DUTY D-C MAN-NETIC CONTROLLERS*

COMBINATION MANUAL and MAGNETIC CONTROLLER FOR CRANES—CHARGING MACHINES—D-C CONTROL JOBS


CAM SWITCH CAN BE MOUNTED REMOTE
OPTIONAL RIGHT OR LEFT-HAND ARRANGEMENT
COMPACT DESIGN ALLOWS INSTALLATION WHERE SPACE IS AT A PREMIUM
HEAVY-DUTY CAM SWITCH WITH REVERSING AND CONTROL CONTACTS . . . "MASTER-SWITCH" EASE OF OPERATION
MOTOR AND RESISTOR TERMINALS READILY ACCESSIBLE
MAGNETIC NEGATIVE LINE AND ACCELERATING CONTACTORS
TOE SPACE FOR OPERATOR'S COMFORT

2 TYPES AVAILABLE: REVERSE-PLUGGING OR DYNAMIC - LOWERING

Provide four speed points, reversing, with all advantages of full-magnetic control. Manually-operated cam contacts are free of destructive arcing . . . extremely fast magnetic contactor action interrupts power circuit before cam-operated contacts are opened. EUCLID'S EXCLUSIVE "TIMELOK" feature offers maximum dependable acceleration timing without extra relays . . . permits unusually compact arrangement of the magnetic panel.

For more information, contact our representative in your area, or write or call THE EUCLID ELECTRIC & MFG. CO., MADISON, OHIO.
Ask for Bulletin 4400-4401.

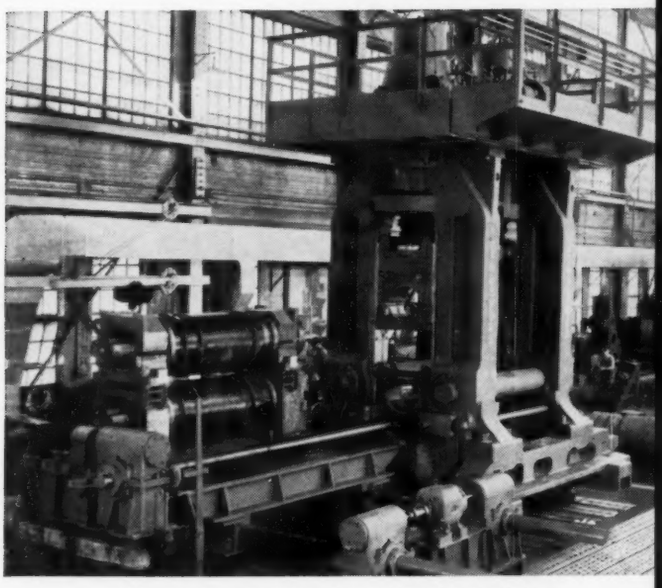
*PATENT APPLIED FOR.

THE EUCLID ELECTRIC & MFG. CO.
MADISON, OHIO

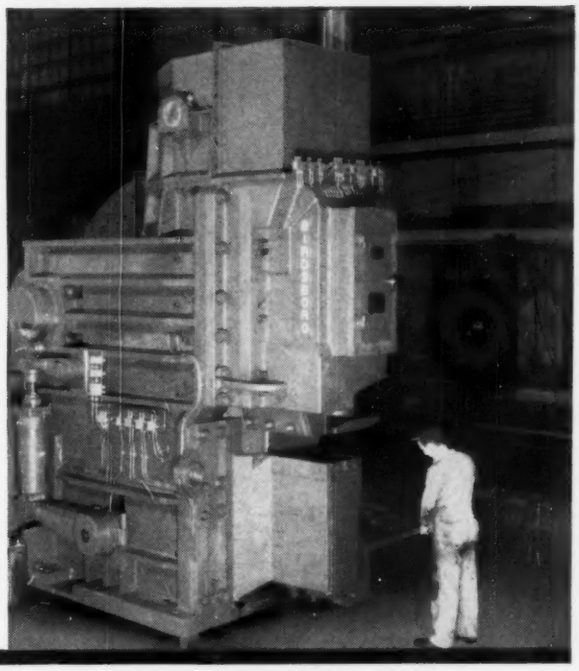
THE EUCLID ELECTRIC
EUCLID
AND MFG. CO. MADISON, OHIO

For the tough competition ahead,
you'll find your key to mill profits
under this name.....

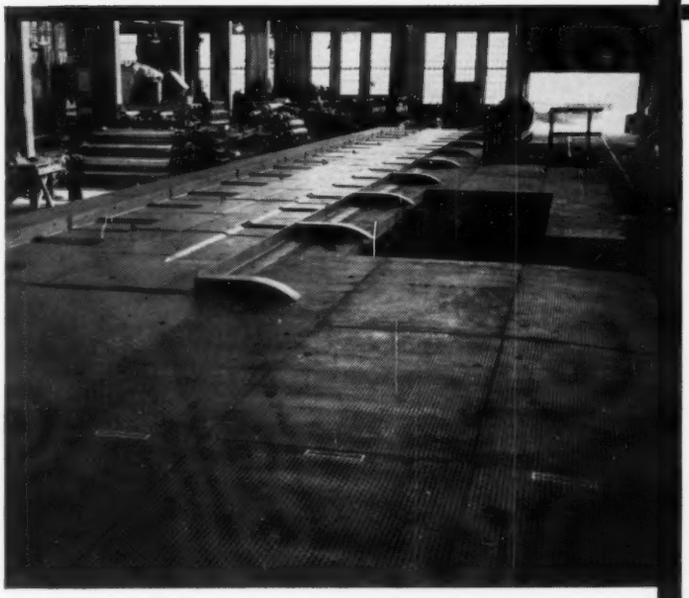
BIRDSBORO



Blooming Mills by BIRDSBORO



Shears by BIRDSBORO



Transfer Tables by BIRDSBORO

•Whatever your particular profitability key unit is... It's sure to be designed, built, and worth more to your company, if it's produced by Birdsboro. Nowhere else can you get the value of more experience and skill ... more background in working on outstanding industrial achievements.

From one piece of equipment to a complete mill, Birdsboro's custom-designing of special machinery will work on the profit side of the ledger for you well into the future. *Main Office, Engineering Department and Plant:* Birdsboro, Pa., *District Office:* Pittsburgh, Pa.

MM-57-58

BIRDSBORO

STEEL FOUNDRY AND MACHINE CO.

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS • Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel

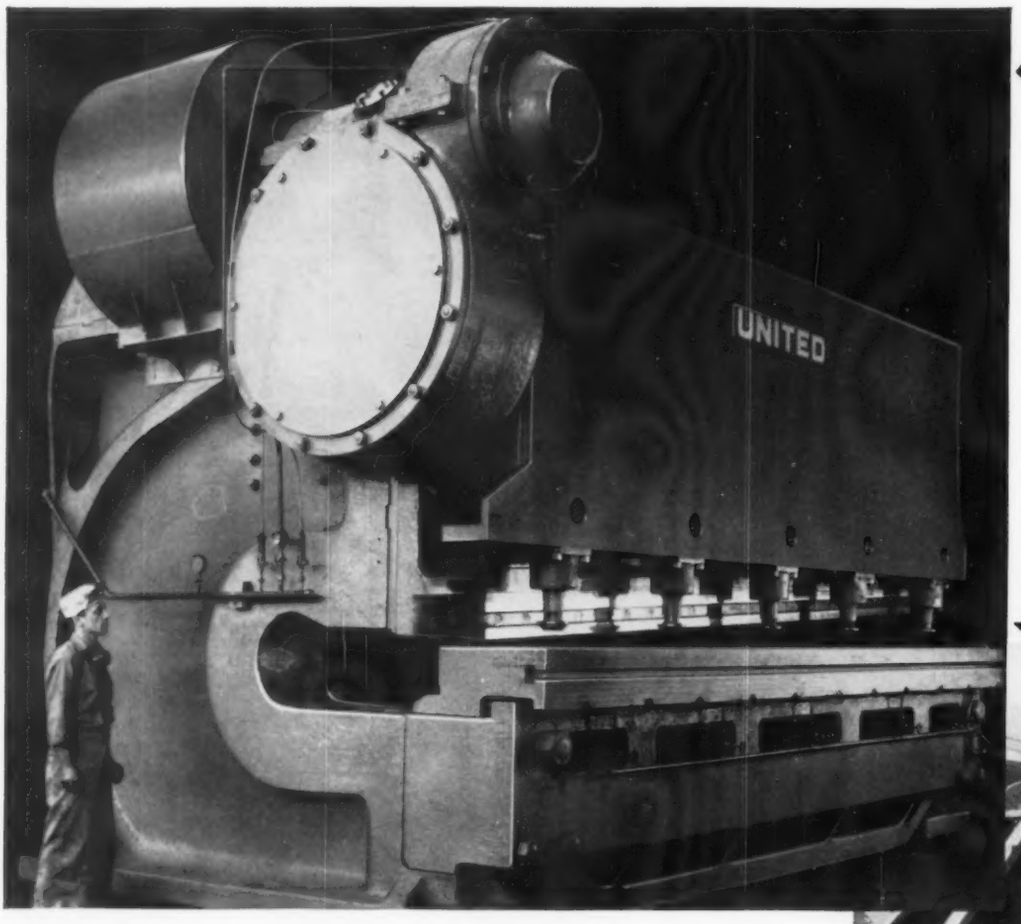


Fig. 1—United's 630,000 psi Cone-Drive geared shear is more compact and streamlined and has a higher capacity than the spur-gear driven shear. Cone-Drive gears are enclosed in compact housing in foreground.

Fig. 2—An older model of a similar shear shows the bulky conventional spur gear drive at the top of the machine.

WORM GEARED SHEAR CUTS 1 9/16" STEEL PLATE UP TO 13' WIDE

An idea of what double-enveloping worm gearing can contribute to steel mill equipment is told, in part, by the accompanying photographs. Fig. 1 shows a United Engineering and Foundry Company 630,000 lb. shear operated through Cone-Drive gearing. Fig. 2 shows an older similar shear—but actually of smaller capacity—driven through conventional spur gearing.

In addition to the reduced bulk and improved appearance of the newer shear, the following advantages have been obtained—largely by designing the shear around compact Cone-Drive gearing:

1. **Capacity increased from 1" thick steel plate, 86" wide, to 1 9/16" thick and 156" wide.**
2. **Drive is enclosed and compact instead of cumbersome and sprawling.**
3. **Flywheel clutch unit and motor mounted to give more effective machine operation.**
4. **Service difficulties have been eliminated. Only an occasional check on lubricant is now required.**
5. **Much quieter and smoother operation.**

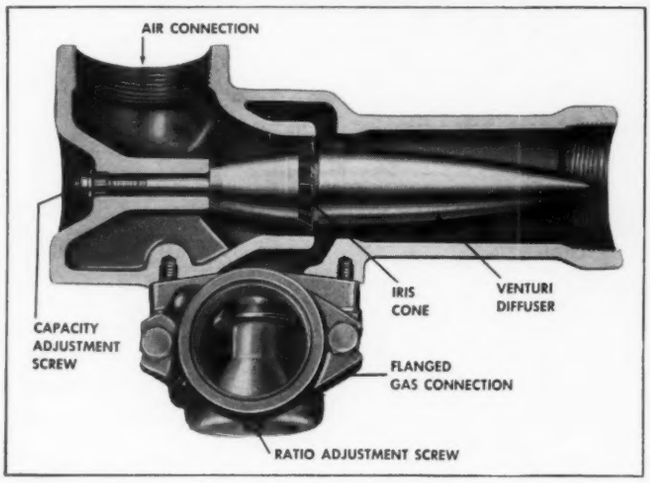
The United shear develops up to 630,000 psi between the knives. Drive is from a 75 hp, 1000 rpm electric motor through a set of Cone-Drive gears with a ratio of 36.5 to 1. This gearing is enclosed in the housing at the upper left corner of the machine in Fig. 1. The compactness of the gearing, making its complete enclosure simple, has contributed considerably to eliminating maintenance difficulties. According to one steel mill: "If we didn't have to check lubricant occasionally, we wouldn't know there were any gears in the case."

Reason for the compactness and freedom from trouble of the Cone-Drive gearing is that these worm gears—differing from others—are "double-enveloping" as a result of a special gear cutting process. In double-enveloping worm gears there are more teeth in contact and more contact per individual tooth. This results in a very high load carrying capacity required for steel mill equipment. It furnishes the positive action of a gear drive with the smoothness of a hydraulic drive.

Complete elimination of backlash is also possible with even the largest Cone-Drive gear sets. Compactness, high load capacity and light weight of these gears permit the use of much smaller gears and housings.

For further information on Cone-Drive worm geared speed reducers and gear sets, write Cone-Drive Gears, Div. Michigan Tool Company, 7171 E. McNichols Road, Detroit 12, Michigan.

You get BUILT-IN *"TUNE-ABILITY"* IN THE *NEW* HAUCK *"ADJUSTA-FLOW"* GAS MIXER



Easiest to adjust on the job for required results

On your furnace burners, you can now eliminate calculating and changing of jets, Venturis, sleeves or rods, yet still maintain extreme accuracy. Here's real "tune-ability" of mixer to burner nozzles and manifold piping without taking anything apart.

1—Superior adjustability of capacity.

2—Revolutionary inverted Venturi diffuser gives shorter mixer length.

3—High capacity ratings.

4—Wide range of turndown.

5—Accurate proportioning of low pressure gas and air.

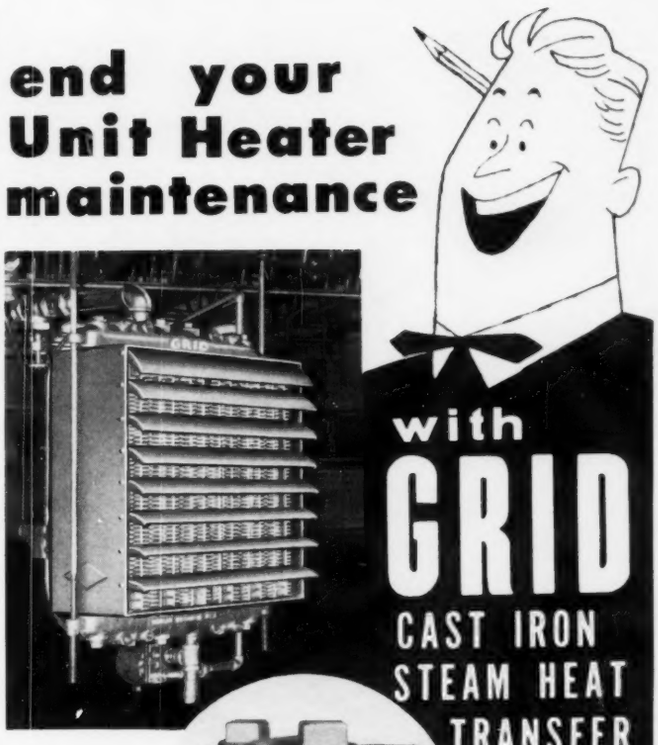
6—Single valve control.

7—Compact design for minimum piping cost and space.

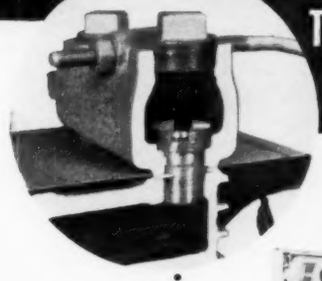
Let Data Sheet No. GB812LA help you.

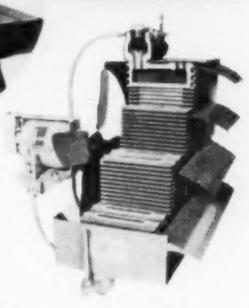
HAUCK MANUFACTURING CO.
Gas and Oil Burners and Equipment
114-124 Tenth Street, Brooklyn 15, N. Y.

end your Unit Heater maintenance



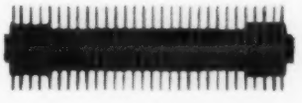
with **GRID** CAST IRON STEAM HEAT TRANSFER SURFACE



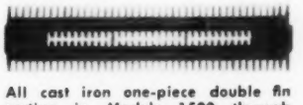


Your answer to unit heater problems the steel industry has discovered through common failures of copper aluminum and steel tube heat transfer surface. GRID condenser eliminates internal electrolytic corrosion —because all metals in contact with steam are similar. GRID also eliminates external corrosion—because the cast iron construction resists acid or other fumes in the air and eliminates the use of reducing valves where high steam pressure is used. GRID cast iron construction is tested to withstand steam pressures up to 250 P.S.I. . . . 450° temperature . . . no soldered, brazed, welded or expanded connections . . . a specially designed threaded nipple provides a leakproof joint. GRID eliminates the high maintenance costs generally experienced with other types of condenser construction . . . eliminates replacement costs because GRID is built to last for years . . uninterrupted service records of more than twenty years are common among GRID users.

Double steam chambers in each fin section . . . fins are cast integral with steam chamber.



All cast iron one-piece single chamber fin section in Models 1000 and 1200 . . . into wide fin spacing.



All cast iron one-piece double fin section in Models 1500 through 3000 . . . wide fin spacing prevents clogging . . . easily cleaned.

Send for the complete story on GRID Unit Heaters, GRID Blast Heaters and GRID Radiation for steel industry use . . . it is contained in GRID Products Catalog No. 956. Write today for your copy.

OUR 75TH YEAR 1883 TO 1958

D. J. MURRAY MANUFACTURING CO.
WAUSAU • WISCONSIN

THIS MAN'S A SPECIALIST IN PROTECTING YOUR PROFITS. His title is Dowell Service Engineer. His job—to study your maintenance cleaning problems, recommend the proper solutions and apply chemical solvents to help you make more profit. He represents a team of specialists who have rendered old-fashioned all other methods of cleaning product, process and steam generating equipment. His method is Dowell Service, the modern way—using solvents—to remove scale and sludge from all kinds of metal equipment, tanks, piping and lines.

Specifically: one processor had been performing his own turnaround service—using mechanical methods—at an annual cost of $315,000. The Dowell Service Engineer and his team performed the same service in 1/10 of the time at a cost of $2300. The savings in downtime alone amounted to $210,000.

If your maintenance and operating engineers do not know the profit possibilities with Dowell Service, ask them to get the facts for you. For specific information on how chemical cleaning can help your plant to greater profits, call the Dowell office nearest you. DOWELL—A SERVICE DIVISION OF THE DOW CHEMICAL COMPANY. Headquarters and research center, Tulsa, Oklahoma, with 165 offices and stations to serve you.

chemical cleaning services for industry DOWELL

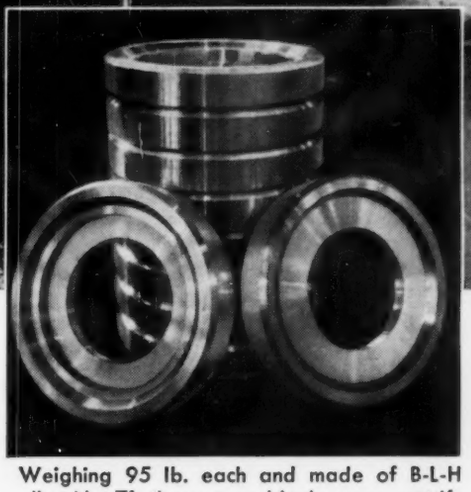
At Eddystone two hot strip mill slippers cast of B-L-H alloy No. 83 are machined on a vertical boring mill.

4 reasons for specifying finish-machined castings by Baldwin

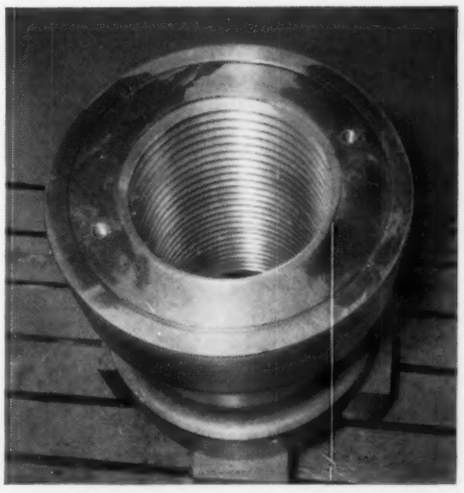
It will pay you to let Baldwin finish machine as well as cast your slippers, gear blanks, and housing nuts. Here's why:

1. Since finish-machined castings are so much lighter than rough castings, your shipping expenses are substantially lower
2. By having the entire operation handled in one shop you save time and place the complete responsibility on one source
3. You eliminate the possibility of receiving defective castings, for any flaws would be uncovered in the machining operation
4. You take full advantage of Baldwin's unexcelled shop facilities, which include spectroscope, electron microscope and X-ray machines, for both research and quality control

For complete finish-machined slippers, gear blanks, housing nuts, or other bronze parts, always look to Baldwin. Write for our illustrated Foundry Bulletin 6002.



Weighing 95 lb. each and made of B-L-H alloy No. 71, these gear blanks were centrifugally cast and machined at Eddystone.



Screwdown unit housing nut cast and finish machined at B-L-H's Eddystone Division.

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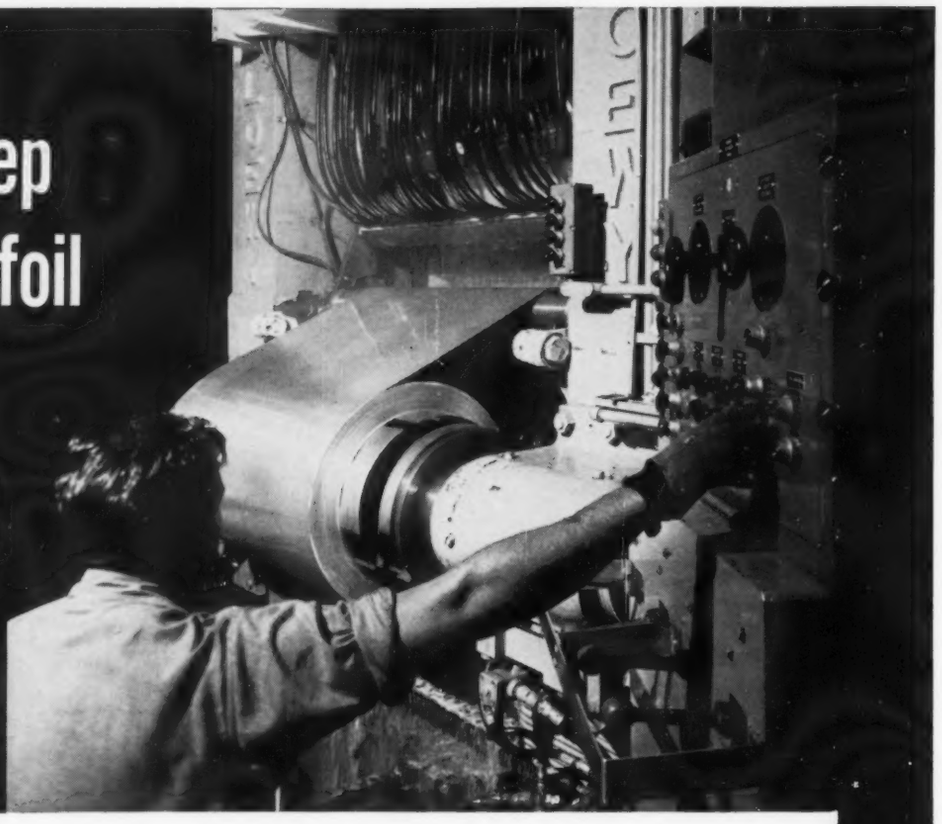
Eddystone Division

Philadelphia 42, Pa.

Hydraulic turbines • Weldments • Dump cars • Nonferrous castings • Special machinery • Bending rolls • Machine tools

how to keep aluminum foil from shattering

... at 35 miles per hour!



Kaiser Aluminum & Chemical Corp. increased annual production of aluminum foil 50% at its Permanente, California plant through installation of a four high foil mill. This mill reduces aluminum strip in thickness from .026 to .00025 of an inch at speeds up to 3000 fpm.

At 35 miles per hour, excessive strain at any of the several reduction stages would shatter the extremely thin foil. From the original payoff reel through to the final rewind, uniform tension is provided by Reliance V★S Drives.

Reliance engineers designed this drive specifically for this mill, to provide the constant uniform tension which is so important.

This application is typical of the many diversified jobs that Reliance V★S Drives are called upon to perform. There is a Reliance V★S Drive to fit your application.

D-1662

For further details, write **Dept. 117-A**

Main control room—Where Reliance equipment provides more than 2,900 hp. to drive this mill.

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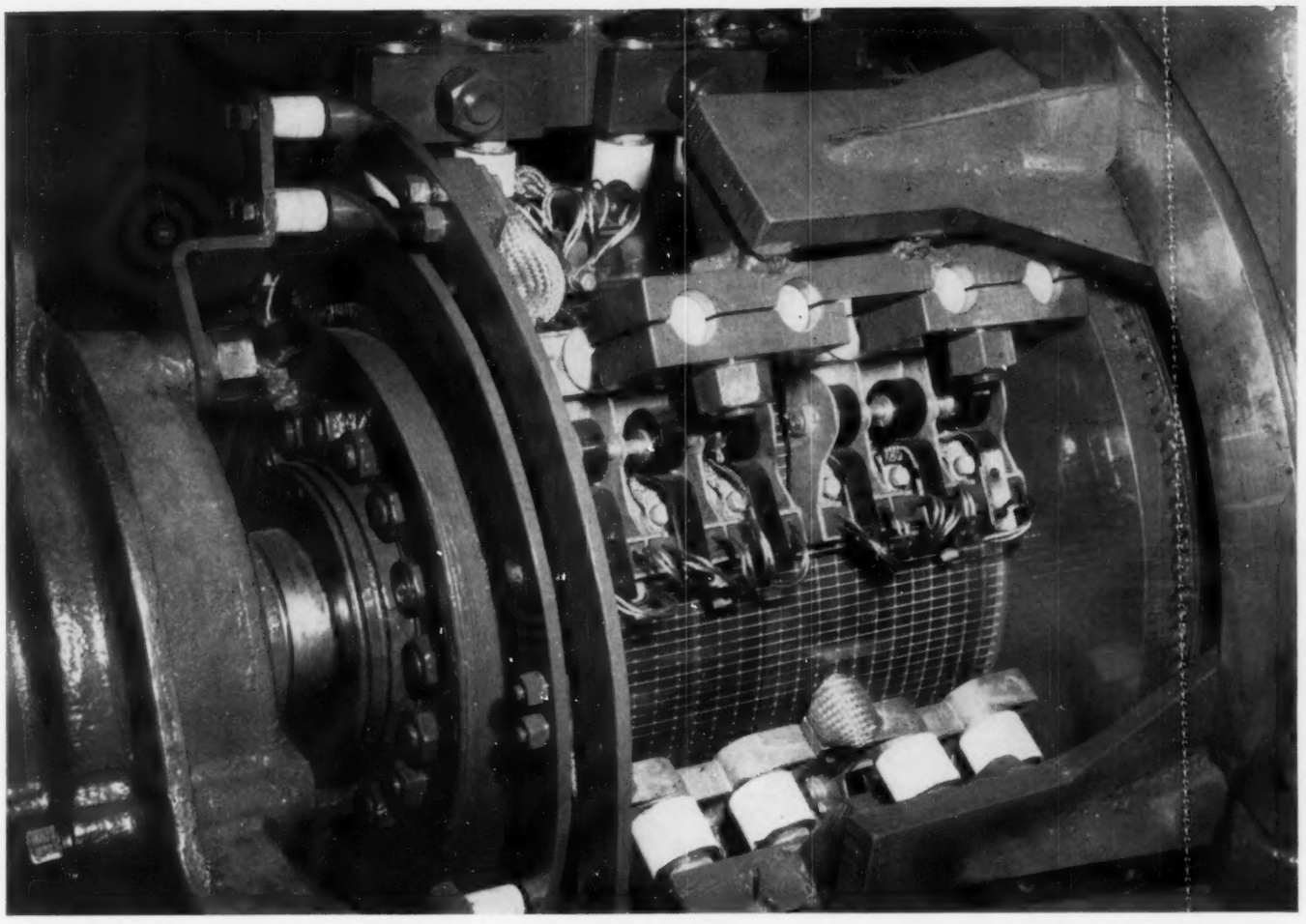

NATIONAL 'Improvement' Saved This Motor from the Scrap Heap

The motor shown above is one of three which powered bridge cranes on an ore unloading dock. After years of operation it was obvious that these motors had reached the point where complete rebuilding would be required to insure continued service.

The motor manufacturer considered the design obsolete and replacement parts were not available. But to replace the motors would have been extremely expensive. Not only would new motors have been required, but the existing crane structure would have had to be modified to accommodate them.

National undertook not merely to repair the motors but to redesign and modernize them. Work done included:

1. design and manufacture of new commutators
2. design and winding of new heavy duty fields
3. rewinding of the armatures
4. design and construction of more rugged brush holders and brush rigging.

As a result of National "repair and improvement", the motors were made more efficient in their performance and less costly to operate and maintain. The peak current demand of the redesigned units is on the order of 6000 amperes as compared to 8000 ampere peaks before rebuilding. And practically all of the parts now required for maintenance are standard stock items.

This case is typical of National repair service. Improvement, not merely repair, is always the objective. For details on how National redesign ingenuity can help *you* solve your tough electrical maintenance problems, just call your nearby National field engineer or drop us a line.

NATIONAL ELECTRIC COIL COMPANY

COLUMBUS 16, OHIO, U. S. A.

TRADE MARK

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION—
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

HOT STRIP MILLS

Designed and Built by MESTA

MESTA 56" Four-High Hot Strip Mill for Rolling Stainless, Silicon, High-Alloy, and Carbon Steels at Allegheny Ludlum Steel Corporation

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

MESTA
THERE IS NONE BETTER

Personnel News...

William R. Howell, works manager at Crucible Steel Co. of America's Midland, Pa., works since 1947, has been appointed assistant to the vice president-operations, with offices at company headquarters in Pittsburgh. Succeeding Mr. Howell as works manager at Midland is **George M. Burrier,** formerly assistant works manager at Midland.

Mr. Howell has been in Crucible's employ for 37 years—all at the Company's Midland works. He joined the company as laborer in 1921, was made open hearth furnace helper and inspector in 1922, chief inspector in 1928, superintendent of the Metallurgical and Inspection Departments in 1943, assistant works manager in 1945, and works manager two years later.

Mr. Burrier has been with Crucible since 1950 when he joined the company as assistant general superintendent at the Midland works. He was named assistant works manager in 1953. He began his career in steel in 1932 when he joined Youngstown Pressed Steel Co. as assistant to product manager. He joined Republic Steel Corp. the following year as a third helper in the Open Hearth Department. With Republic he also held the following jobs: melter foreman, assistant open hearth superintendent, assistant open hearth and electric furnace superintendent, open hearth superintendent, and a special assignment as secretary of the open hearth committee.

George R. Goss was named general superintendent of the hot and cold strip mills at Republic Steel Corp.'s Gadsden, Ala., plant. Before taking over his newly-created position, Mr. Goss was assistant superintendent of Republic's cold strip mill in Cleveland, Ohio. The Gadsden hot and cold strip mills will continue under the direction of their respective superintendents, **E. H. Callahan** and **J. J. Lloyd,** with Mr. Goss having over-all supervision.

Mr. Goss joined Republic in 1934 as a laborer in the Warren hot strip mill. He transferred to Cleveland in 1937 as a strip mill recorder and worked in various jobs in the ensuing years. He became a turn foreman in 1945 and general foreman in 1950, advancing to the assistant superintendent's job in 1953.

W. Truxton Purvance was appointed project analysis engineer for United States Steel Corp. Mr. Purvance was formerly works engineer for Columbia-Geneva Steel's Geneva Works near Provo, Utah. He began his employment with U. S. Steel in 1942, when he worked as a field draftsman on the original boundary survey of the Geneva Plant. In 1944, he was appointed civil engineer for Geneva and advanced through the posts of construction engineer and assistant chief engineer, Geneva Steel, before his promotion as works engineer in 1952.

Carl I. Collins was named vice president and assistant to the president of Copperweld Steel Co. He had been vice president in charge of the Superior Steel Div. of Copperweld at Carnegie, Pa. Prior to the acquisition of Superior by Copperweld last November, Mr. Collins was president of the Superior Steel Corp. **Joseph W. Kennedy, Jr.,** was named vice president in charge of the Superior Steel Div. Mr. Kennedy had been vice president of Copperweld's Ohio Seamless Tube Div. at Shelby, Ohio. During his earlier years with Copperweld he held several executive positions with the Aristoloy Steel Div. at Warren, Ohio. **Reid M. Pittenger** was promoted to vice president in charge of the Ohio Seamless Tube Div. He was formerly manager of industrial relations, an l had served previously as assistant manager of operations for that division.

Charles R. Tyson has been elected executive vice president of the Colorado Fuel and Iron Corp. Mr. Tyson is also executive vice president of John A. Roebling's Sons Corp., a wholly-owned subsidiary. He has held this post since the Roebling firm was acquired by CF&I in 1952, and has been a member of the board of CF&I since 1953. Mr. Tyson joined the company in 1935 as a student trainee and worked in various departments including the open hearth and wire mills. In 1936, he was elected treasurer and named to the board of directors of the company. He became secretary-treasurer in 1940. In 1944 he was elected president.

Charles T. Fettel was named superintendent of the merchant-skelp mill at Kaiser Steel Corp's., Fontana,

W. R. HOWELL

G. M. BURRIER

G. R. GOSS

W. T. PURVANCE

A. C. FISHER

RALPH F. DORSHIMER

K. O. SCHNEIDER

R. J. SAHR

Calif., plant. He replaces **William H. Boyle,** who has retired. Mr. Fettel, who has been with the company since 1946, had served as assistant superintendent of the merchant-skelp mill since 1953. Prior to that, he was a foreman in the cold roll mill in 1946, a general foreman in the conditioning yards in 1947 and general foreman in the structural mill from 1948 to 1953. Mr. Fettal joined Kaiser after spending 17 years with the Wisconsin Steel Works of the International Harvester Co.

Albert C. Fisher was elected vice president in charge of sales and engineering of the Pittsburgh Engineering and Machine Div., Pittsburgh Steel Foundry Corp. For the past 30 years, Mr. Fisher has been associated with the Blaw-Knox Co., recently as assistant vice president of engineering and sales in the Foundry Mill Machinery Div.

Ralph F. Dorshimer was appointed chief engineer of Treadwell Engineering Co.

Kenneth O. Schneider was appointed to the position of vice president in charge of manufacturing, Appleton Electric Co. Mr. Schneider joined Appleton in 1949 as an industrial engineer. This was followed by his appointment in 1954 to the position of works manager of the Chicago plant. Also announced at the same time was the promotion of **Murray J. Mauritzen** to works manager, the position vacated by Mr. Schneider. Mr. Mauritzen moved up from his position as production control manager. He joined the Appleton organization in 1948.

Robert J. Sahr has been appointed president of Thermal Transfer Corp. Vice president in charge of sales since 1954 and vice president in charge of operations since 1956, Mr. Sahr succeeds the late **Walter H. Scheib.** Mr. Sahr was formerly a sales engineer and had previously been metallurgical development engineer for the Silver Steel Co. and Silver Engineering Co. of Denver, Colo.

W. H. Thomas has been promoted to general superintendent—Coke & Iron Div., Pittsburgh Coke & Chemical Co. **John S. Dods** was named assistant general superintendent, and **Robert W. Hanlon,** superintendent, Coke & By-Products Department. All three have spent their entire careers of 25 years or more with the company. The promotions were prompted by the consolidation of the company's Steam & Power, and Basic Maintenance Department within the Coke & Iron Div.'s functions.

William H. Matthews was named manager—coke production, Indiana Harbor Works, Inland Steel Co., the post formerly held by the late **Clarence L. Corban. Harry A. Hager,** formerly superintendent—plant 3 coke plant, becomes superintendent—plant 2 coke plant, succeeding Mr. Matthews. **Ernest Underwood** has been promoted from assistant superintendent—plant 2 coke plant, to superintendent—plant 3 coke plant. **Charles E. McMorris,** formerly assistant general foreman—plant 2 coke plant, now is assistant superintendent—plant 2 coke plant.

Clarence E. Peck, metallurgical process consultant, Westinghouse Electric Corp., has received the Trinks Award for his development of controlled gas atmosphere systems and equipment for industrial furnaces. He was recently re-assigned to the Westinghouse East Pittsburgh Works after 11 years at the company's Meadville, Pa., plant. Two others similarly honored were: **Joseph Needham,** combustion engineer, inventor of burner devices and one-time president of Needham Gas Appliance Co., and **Dr. Robert B. Sosman,** professor of ceramics at Rutgers University, and former assistant director of U. S. Steel Corp. Research Laboratories, Kearny, N. J.

William C. Campbell has been appointed superintendent of merchant mills, Youngstown District, the Youngstown Sheet and Tube Co. He succeeds **Clark S. Lambert,** who has retired after nearly 21 years of service with the company.

Mr. Campbell joined Youngstown Sheet and Tube in 1934 as a stocker in the sheet mill and worked in various positions in the mill. He subsequently served as an industrial engineer, general industrial engineer and division industrial engineer. He became assistant superintendent of merchant mills, the position he held at the time of his most recent promotion, in 1954.

Mr. Lambert, joined Youngstown Sheet and Tube in 1937 after serving with the U. S. Steel Corp. and the Cambria Steel Co. He became superintendent of the merchants mills in 1944.

Harry Davis, superintendent of open hearth No. 3, and **Robert Latham,** superintendent of the iron foundry, both at the Bethlehem, Pa., plant of Bethlehem Steel Co., have retired. Mr. Davis has been with the company more than 35 years and Mr. Latham over 42 years. **A. P. Smith,** formerly assistant to superintendent of No. 3 open hearth, has been named to succeed Mr. Davis

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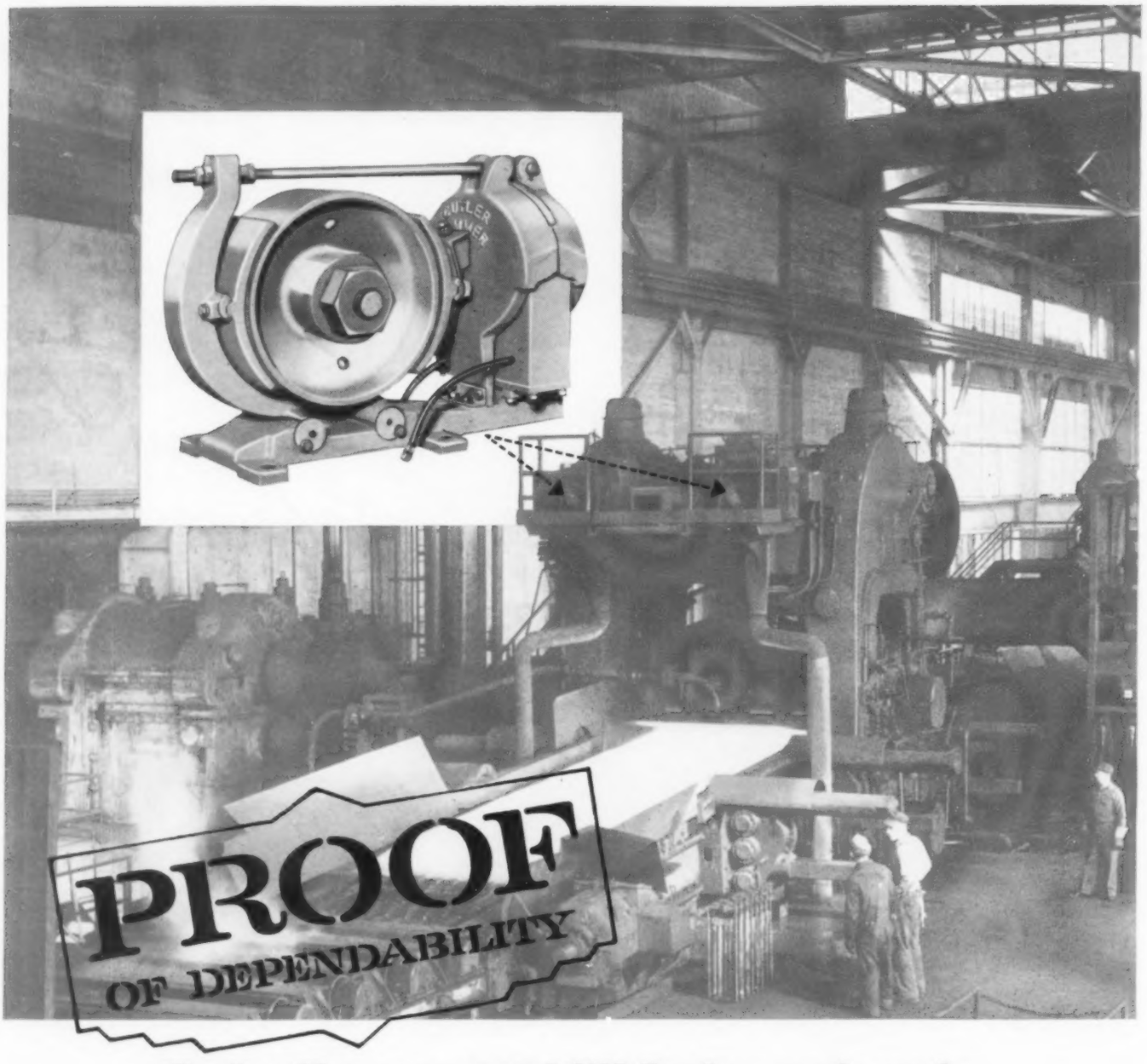

Cutler-Hammer 505 Mill Brakes end costly production interruptions at a large Midwest Steel Plant

Here's dramatic evidence Cutler-Hammer 505 Mill Brakes are designed right to work better and last longer. A large Midwest Steel Plant had been using another make of Mill Brakes on their mill screwdowns and found it necessary to interrupt production frequently to repair these brakes. The brakes required adjustment weekly . . . followed by monthly overhauls.

Then the brakes on one mill were replaced with 23" Cutler-Hammer 505 Mill Brakes, and the results were most amazing. The Cutler-Hammer 505 Mill Brakes worked continuously . . . perfectly with only minor adjustments for lining wear . . . and even these adjustments could be accomplished without halting the mill. As a result, the Shop Electrical Superintendent turned in a *Cost Reduction Report* prompting the plant's standardization on Cutler-Hammer 505 Mill Brakes.

This is positive proof of dependability . . . proof that Cutler-Hammer 505 Mill Brakes work better and last longer even under the most severe operating conditions. Why take chances with costly production interruptions? Specify Cutler-Hammer 505 Mill Brakes and be sure. For complete information write today for Bulletin 505. CUTLER-HAMMER Inc., 1269 St. Paul Avenue, Milwaukee 1. Wisconsin.

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and **D. E. Best,** superintendent of the brass foundry, to succeed Mr. Latham. Mr. Best will continue to be responsible for the brass foundry operations.

H. E. Lore has been appointed manager of the Engineering and Construction Department of the Machinery Div. of Dravo Corp. Mr. Lore joined Dravo in 1936 as an engineer in the Air Conditioning Department. Since that time he has served in various engineering and operating capacities in the company. He was named operations manager of the Engineering and Construction Department in 1955.

Jacques W. Lourie has been named director of foreign sales for Baldwin-Lima-Hamilton Corp.'s six industrial divisions. He will co-ordinate all foreign sales activities for heavy industrial products of the corporation. A mechanical engineer and for many years director of exports of Loewy-Hydropress, Mr. Lourie will continue to make his headquarters in New York.

Jack W. Swantz was recently appointed district manager of Wheelabrator Corp.'s Pittsburgh sales office. He will fill the position vacated by **J. F. Underway** who recently resigned to operate his own foundry in South Dakota. **Robert F. Morgan** and **Rufus F. Duff** have also been appointed to Wheelabrator's Pittsburgh office. Mr. Morgan is a sales engineer and Mr. Duff is an abrasive engineer. **Charles L. Benham** has retired as district manager of Wheelabrator's Springfield, Mass., sales office. Mr. Benham will remain active in an advisory capacity. He had been employed by Wheelabrator for 48 years. **John H. Burlingame** has been promoted to district manager of the Springfield sales office to succeed Mr. Benham. Mr. Burlingame has been assisting Mr. Benham in the Springfield territory as district sales and service engineer since 1953. **Robert G. Pfliegel** has been appointed the new district sales and service engineer.

Robert C. Hiltbrand has been appointed manager of export sales by the Electric Furnace Co. Joining the organization in 1938 he has served in their mechanical engineering, field erection, electrical and fuel divisions, and other departments.

Niland B. Mortimer has been appointed a sales engineer in the Crane and Bridge Sales Department of Dravo Corp.'s Engineering Works Div. Mr. Mortimer previously served as a design engineer.

W. J. Lyons has been appointed manager of Elliott Co.'s Newark, N. J., district office. Mr. Lyons joined Crocker-Wheeler in 1948, and served in the Philadelphia and Washington offices. Since 1954, he has been manager of the Charlotte, N. C., district office.

A. P. Grimm was named manager of the Milwaukee, Wis., district office. He joined Elliott in 1951 as field engineer in the Philadelphia office. He was assigned to the Wilmington sub-district office in 1952.

C. E. Cromwell has been appointed manager of commercial sales, De Laval Steam Turbine Co., Inc. In addition to his new position, Mr. Cromwell will continue as field sales manager. He has been with De Laval for 21 years, and was Detroit district manager from 1946 to 1957. **A. L. Foltz, Jr.,** manager of the Detroit district office since 1953, has been appointed manager of the

C. E. CROMWELL

C. H. LEET

Chicago office. **J. F. Donovan,** a De Laval sales engineer for the past nine years, with tours of duty in the Detroit and Kansas City Offices, has been appointed Manager of the Detroit district office.

C. H. Leet, has been appointed to handle the Electric Products Co. line which Exide Industrial Div. of The Electric Storage Battery Co. began in March to market exclusively. Mr. Leet will direct sales of battery charging equipment. Associated with Exide for nearly 20 years, Mr. Leet was a sales engineer and branch sales manager in the Pittsburgh area. Since 1954, he was assistant sales manager in Exide's Chicago branch.

William C. Decker, president of Corning Glass Works has been elected chairman of the board of directors of Corhart Refractories Co., Inc. He succeeds **Frederick C. Thompson,** who will continue to serve as a director.

Ralph L. Chamberlin has been appointed director of engineering by Research-Cottrell, Inc. He has been employed by Research-Cottrell in various engineering capacities since 1934.

W. H. Mouquin was named manager of De Laval Steam Turbine Co.'s newly-established New York district office. The new office will provide direct sales and service facilities for De Laval products formerly handled by the Turbine Equipment Co. of New York. Mr. Mouquin joined De Laval in 1955 as manager of the Chicago district office.

John W. Mayers has been promoted to the position of chief engineer of the Pittsburgh Coke & Chemical Co. Mr. Mayers joined Pittsburgh Coke & Chemical in 1955. He had previously been associated with the Sharples Chemical Division of Pennsalt Chemicals Corp. as chief engineer, and with the Monsanto Chemical Co.

Robert N. Wagner has been appointed chief electrical engineer for Aluminum Co. of America, succeeding **Louis N. Grier,** who retired from active service July 1 after 39 years of service. Mr. Wagner has been assistant chief electrical engineer for Alcoa since 1957. Previously he held staff positions in the electrical departments at the company's Massena, N. Y., Vancouver and Mead, Wash., operations. He has served with Alcoa since 1937. Since 1950, he has supervised all phases of electrical construction for the company's expansion program. Mr. Grier joined Alcoa in 1919. During his career with the company, he was responsible for numerous advances in the design of electrical equip-

ment utilized in both the smelting and fabrication of Aluminum.

John P. Cartwright has been elected vice president and general manager of the Industrial Division of Joy Manufacturing Co. At the same time, **J. Y. Richards** has been appointed to fill Mr. Cartwright's former position as sales manager of the Industrial Division. Mr. Cartwright, who joined the company in 1950, served successively as government sales representative and subsequently as district sales manager in Washington, D. C. He was named sales manager of the Industrial Division in 1956. Mr. Richards was, until his appointment, district manager of Joy's Chicago sales district. He was named to that position in 1948. Prior to that, he served in general sales, and was assistant district manager of the Chicago district. He joined the Sullivan Machinery Co., a company acquired by Joy in 1946.

Wilson P. Burns has been named manager of the Cleveland Works of National Malleable and Steel Castings Co. He will replace **Stewart Tame,** Cleveland works manager since 1942, who is retiring after 35 years' with the company.

Mr. Burns worked for Bethlehem Steel Co. for two years, and joined National Malleable in 1937. He was made assistant plant superintendent of the Sharon Works in 1946, and superintendent in 1948.

Lawrence G. Blackmon will replace Mr. Burns as general superintendent at Sharon. Mr. Blackmon joined Carnegie-Illinois Steel Corp. in 1940. He joined National Malleable as a time study engineer in 1946. He became manager of the production department at the Sharon Works in 1951, and superintendent of the finishing department in 1952.

John W. Belanger was appointed general manager of General Electric Co.'s Apparatus Sales Division. Mr. Belanger, a General Electric vice president, succeeds the late **William V. O'Brien,** who died June 21. Mr. Belanger joined General Electric in 1917 as a student engineer at Lynn, Mass. He successively held engineering and sales positions in Schenectady, N. Y., and Philadelphia as an arc welding specialist. He subsequently joined the Philadelphia office of the Industrial Department as a salesman contacting steel mills and oil refineries. In 1930, he was named head of marine sales for the Philadelphia District. In 1940, Mr. Belanger returned to Schenectady as assistant manager of the Federal and Marine Divisions, and in 1943 became manager of the divisions. He was appointed assistant sales manager of the Apparatus Department in 1945. He became manager of General Electric's Turbine Divisions in 1947, and two years later was appointed assistant general manager of the Apparatus Department. In 1951, when the Apparatus Division was reorganized, he became general manager of the Large Apparatus Division. Later that year Mr. Belanger was elected a company vice president and appointed general manager of the newly-created Defense Products Division. The division was redesignated the Defense Products Group in January, 1952, and Mr. Belanger was named group vice president. He was elected an executive vice president in 1954, and was assigned responsibility for the Industrial Products and Lamp Group. This group was redesignated the Industrial Components and Materials Group in 1955. Two years later, the title of executive vice president was discontinued, and Mr. Belanger became vice president, continuing as group executive.

A. J. Cooper retired July 1 after 49 years of service with Allis-Chalmers Manufacturing Co. Mr. Cooper joined Allis-Chalmers graduate training course in 1909. After serving as a specialist for the company on street railway air compressor equipment for about eight years, he transferred to Allis-Chalmers New York office in 1920. He was appointed New York district manager for Allis-Chalmers in 1945 and empire region manager in 1947, a post he held until 1958 when the empire and New England regions were combined into the Northeast Region.

John R. Wall has been named general traffic manager of Republic Steel Corp. Mr. Wall, assistant general traffic manager for the past two years, succeeds **R. A. Eldridge** who asked to be relieved of some of his responsibilities because of ill health. Mr. Eldridge will continue with the company as a special assistant on traffic and related problems under the executive staff of the corporation. He also will continue as vice president of Liberia Mining Co., Ltd., and as president of the Lake Champlain and Moriah Railroad.

Obituaries

Ernest G. de Coriolis, director of research of the Surface Combustion Corp., died May 18. He was 75. From 1909 until 1915 Mr. de Coriolis was chemist, superintendent and manager of the Canada Starch Co. For the next 10 years he was in various engineering capacities. In 1925 he joined Surface Combustion in Boston, and three years later became director of research of Surface Combustion in Toledo.

Lewis C. Sowell, superintendent—blooming and rolling mills, Aliquippa Works, Jones & Laughlin Steel Corp., died June 3.

S. S. Callner, partner with S. S. Callner & Co., Chicago, Ill., died June 3.

L. A. Wynd, electrical superintendent, Republic Steel Corp., Chicago, Ill., died June 5.

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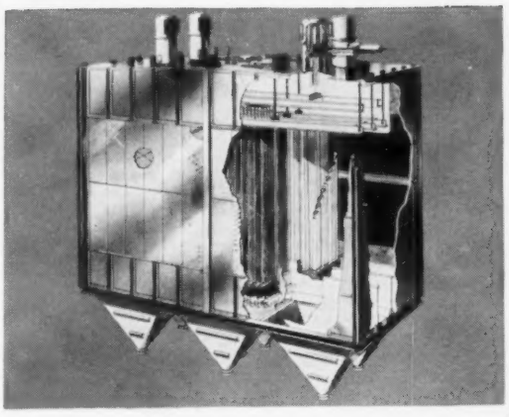

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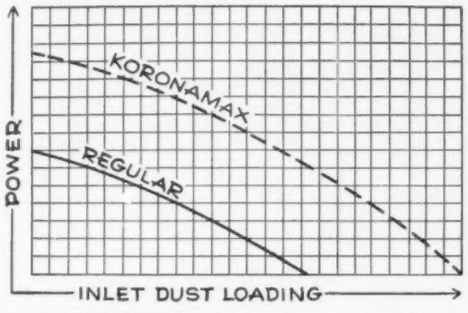
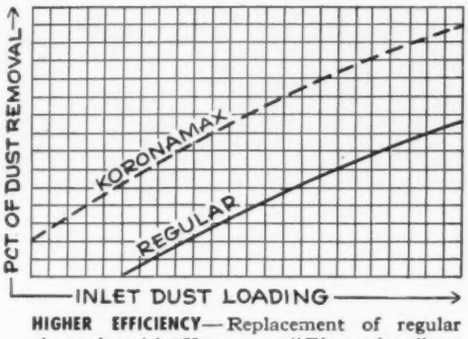
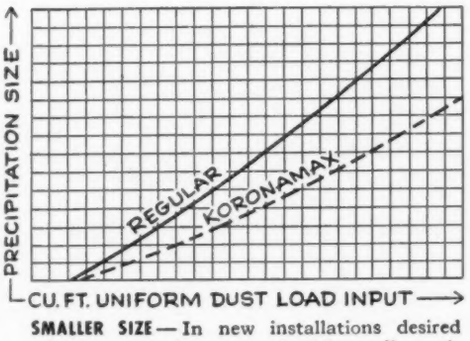


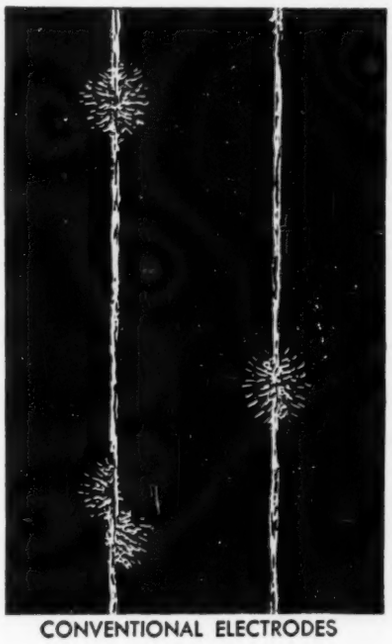
INCREASED POWER—The evenly spaced discharge points of "Koronamax" Electrodes reduce the arc-over tendency and permit increasing power input.



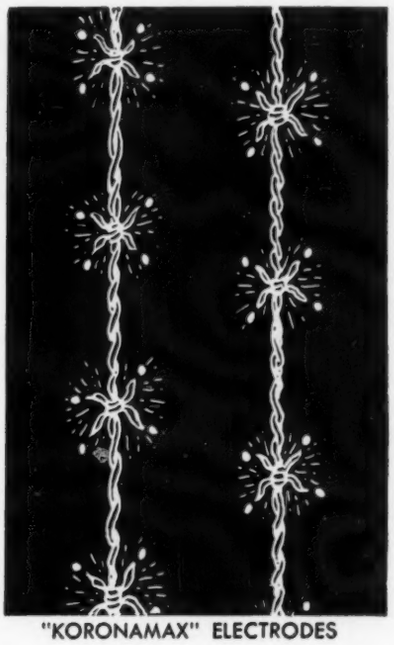
HIGHER EFFICIENCY—Replacement of regular electrodes with "Koronamax" Electrodes allows higher power input — greatly increased efficiency.



SMALLER SIZE—In new installations desired efficiency may be obtained with smaller unit when "Koronamax" Electrodes are used.



CONVENTIONAL ELECTRODES



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Engineered Products Sold with ***Service***

YESTERDAY it wasn't there. Today, he picks it up and wonders: *why did it grow like that?* The miracle of growth! Whether it's a "toadstool" that springs up overnight or a cancer cell that suddenly comes into being, we've a lot to learn about the whole beautiful process of orderly growth . . . and the dreadful, senseless growth that is cancer.

The cancer puzzle is tied up in growth —growth of body cells smaller than the periods on this page.

Scientists, working under grants from the American Cancer Society, are ceaselessly studying cells—normal and cancer cells. And they too are asking: *Why?*

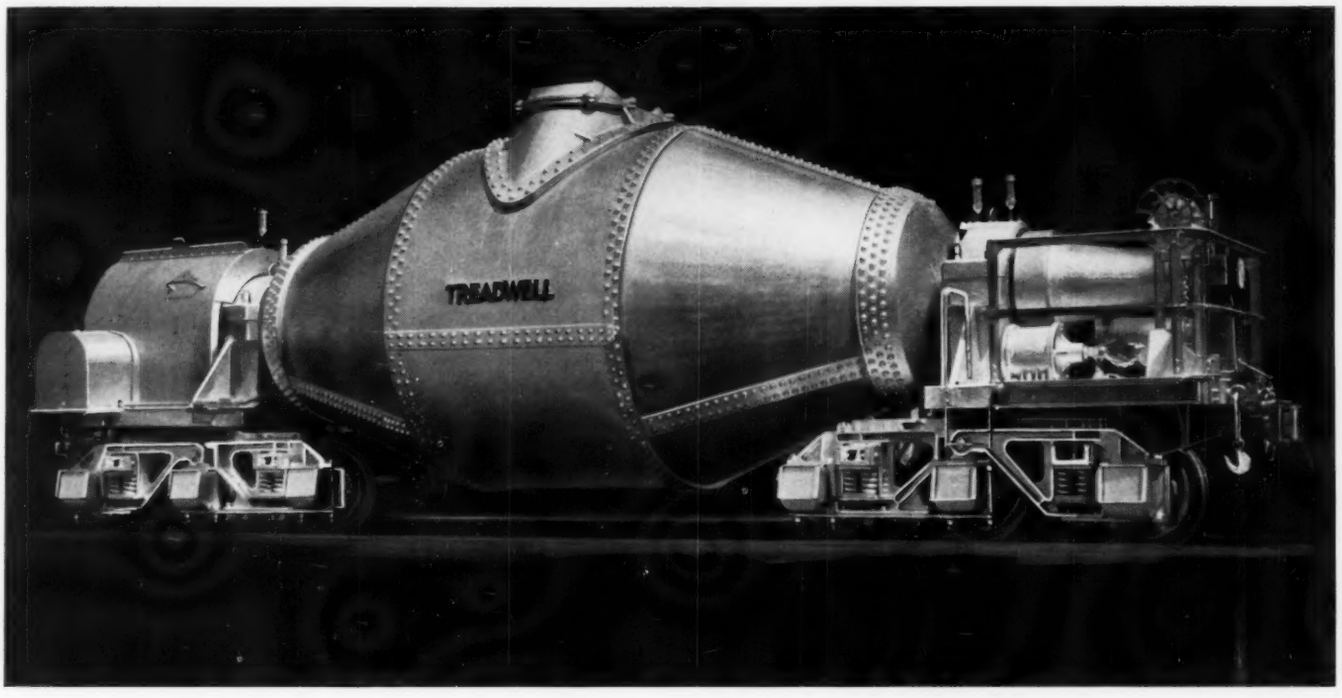
Why do cells suddenly change from normal growth to uncontrolled, disorderly growth? This question can be answered only by the most probing, painstaking and costly research.

Your contributions to the American Cancer Society will support hundreds of scientific studies necessary to save lives today and tomorrow.

Remember: Cancer can strike anyone. But you can strike back *hard* with your dollars. Send your gift to CANCER in care of your local post office.

AMERICAN CANCER SOCIETY

Now it's over 500 mixer-type hot-metal cars by TREADWELL



PURCHASERS OF TREADWELL MIXER-TYPE HOT-METAL CARS

Algoma Steel Corporation, Ltd.	13
Altos Hornos DeMexico S.A.	3
Armco Steel Corporation	30
Australian Iron and Steel Ltd.	5
Bethlehem Steel Company	109
Colorado Fuel and Iron Corporation	21
Crucible Steel Company of America	4
Detroit Steel Corporation	6
Dominion Foundries and Steel Ltd.	6
Ford Motor Company	8
Granite City Steel Company	15
Great Lakes Steel Corporation	32
Guest Keen Iron and Steel Company, Ltd.	5
Inland Steel Company	33
Jones and Laughlin Steel Corporation	37
Kaiser Steel Corporation	23
Lone Star Steel Company	1
McLouth Steel Corporation	10
Pittsburgh Steel Corporation	8
Republic Steel Corporation	50
Richard Thomas and Baldwins Ltd.	1
Sociedad Mixta Siderurgia Argentina	2
Steel Company of Canada	6
The Steel Company of Wales, Ltd.	3
U. S. Pipe & Foundry Company	3
U. S. Steel Corporation	80
Wheeling Steel Corporation	4
Youngstown Sheet and Tube Company	28

The companies listed at the left have purchased, between them, a total of 546 Treadwell mixer-type hot-metal cars. This fact is eloquent testimony to the efficiency and economy of these cars.

Practically all users report no ladle skulls are formed in Treadwell mixer-type cars. Heat retention is greater... lining costs lower... use of coke braize and stationary mixers not needed.

Designed to suit a wide variety of needs, cars range in capacity up to 200 metric tons. They are equipped with a motor-operated dumping device and a hand mechanism for rotating the ladle in case of power failure.

Treadwell engineers will be pleased to discuss your requirements for hot-metal cars. In the meantime, send for a free copy of illustrated bulletin—"Treadwell Mixer-Type Hot-Metal Cars."

M. H. TREADWELL COMPANY, INC.

140 Cedar Street, New York 6, N. Y.

1015 Farmers Bank Bldg., Pittsburgh 22, Pa. 208 So. LaSalle St., Chicago 4, Ill.

TREADWELL

MIXER-TYPE HOT-METAL CARS

TR-26

POOLE Flexible Couplings

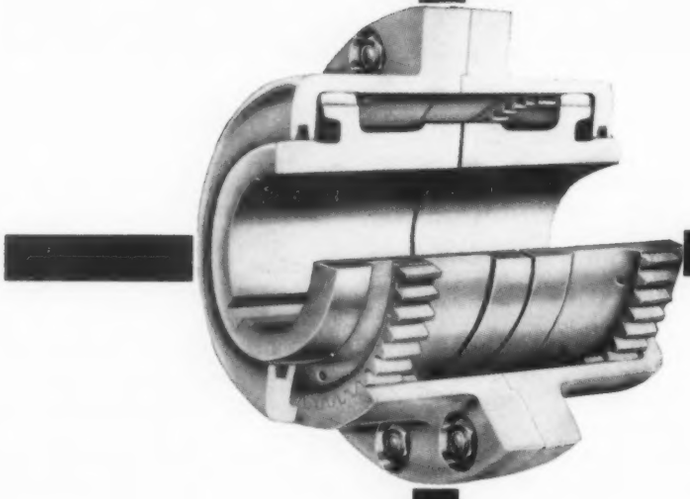
Look at these features—many of them exclusive with the patented POOLE:

Adjusts itself to all conditions, leaving its members free to float without strain to parts.

Geared type providing great strength, the highest efficiency of modern flexible coupling design.

No flexing materials to crystallize or break . . . No welded parts . . . Filled with oil, self-lubricating . . . Oil tight, dust tight . . . Permits free lateral float . . . Stronger than shafts it connects . . . Compensates for both off-set and angular misalignment.

Steel mill drives equipped with POOLE FLEXIBLE COUPLINGS.



Get the whole story from our handbook, "Flexible Couplings." A copy will be sent gladly without obligation.

the better

FLEXIBLE COUPLING

POOLE FOUNDRY & MACHINE COMPANY

1700 UNION AVE.

BALTIMORE 11, MD.

Safety SPRING CARTRIDGE . . . Self Contained . . . Quickly Replaceable!
Engineered for Easy Installation and SAFE MAINTENANCE In All Weather!
Check these Super Service Features of
APPLETON
Automatic Cable Take-Up
REELITES*
Patent Pending
Snap-On or Threaded Covers. NO SCREWS Release in Seconds!
NO SPECIAL TOOLS Required for Maintenance . . . Only A Screw Driver!
One Piece UNI-CAST Main Frame . . . for Perfect Alignment, Light-Weight!
HOLLOW SHAFT Construction . . . Pressure-type Internal Cable Grip . . . Fast Cable Replacement!

A Host of Features that Give You Safe, Uninterrupted Service and Cut Maintenance Costs!

■ There's an APPLETON REELITE built to fit *your* requirements. The ALL NEW RL Series is designed for easy installation, quick, safe servicing and years of trouble-free operation! Your choice of weather-proof or explosion-proof designs. Multiple conductor units available. Newly designed spring motors with finest spring steel for longer life. A safety spring cartridge is self-contained and quickly replaceable for fast servicing when needed.

In addition, with APPLETON you find floating tension brushes for uniform pressure and arc-less contact on newly designed collection rings. Your choice of a wide range of accessories for custom installation, too, *from stock!*

**Newly Designed! Weather-Proof or Explosion-Proof!*

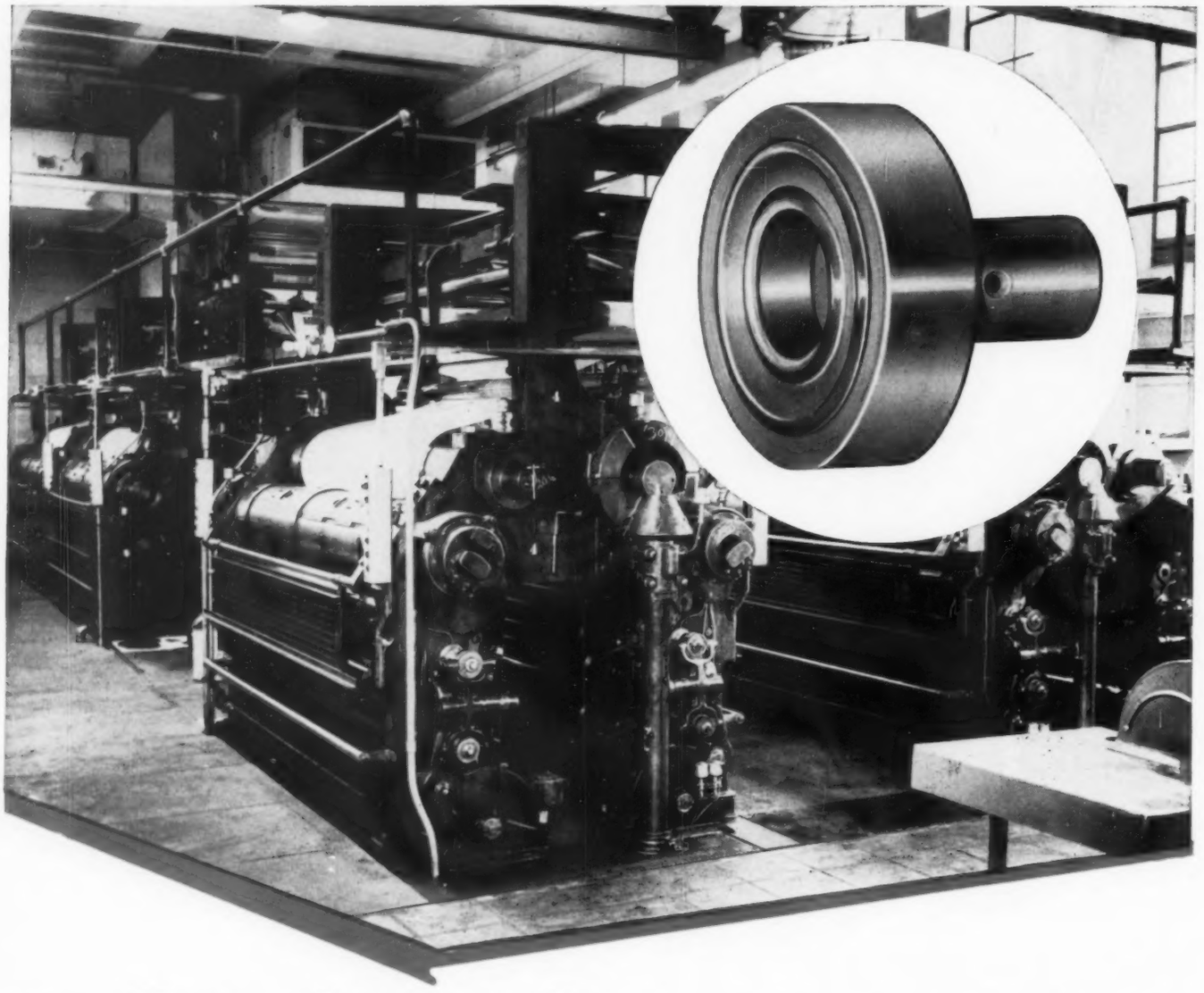
**Only APPLETON Manufactures REELITES!*

Write for Bulletin 504

APPLETON ELECTRIC COMPANY
1701 Wellington Avenue • Chicago 13, Illinois

APPLETON ELECTRIC - PRODUCTS ®

Also Manufacturers of:



It's Bearings, Inc. wherever shafts or wheels turn. We have the experience . . . . the bearings to solve any problem!

Even on printing presses such as this at the Warren, Ohio, Tribune Chronicle. As originally built, the shafts on the ductor and plate rolls turned in a metal to metal housing. Wear on the shafts made complete adjustments necessary with every roll change. The rolls would not distribute the ink properly and the printed pages were heavy with ink on one end, light on the other.

By incorporating the studded bearing housing, shown above, all the rolls are held evenly and adjustment remains constant. All shafts were shortened to accommodate the bearing housing stud length, with anti-friction bearings.

Fifty of these housings and ball bearings are now installed and according to the press room foreman, Jack Marlin, they are doing a great job. Roll changes are now made in much less time and the ink is evenly distributed over the printed pages.

You probably don't have a printing press in your plant, but you would be exceptional if you didn't have bearing problems — We're on call, 24 hours a day, to help you solve them — Call the branch nearest you for quick, experienced service.

Providing bearing service in the North →

BEARINGS, INC.

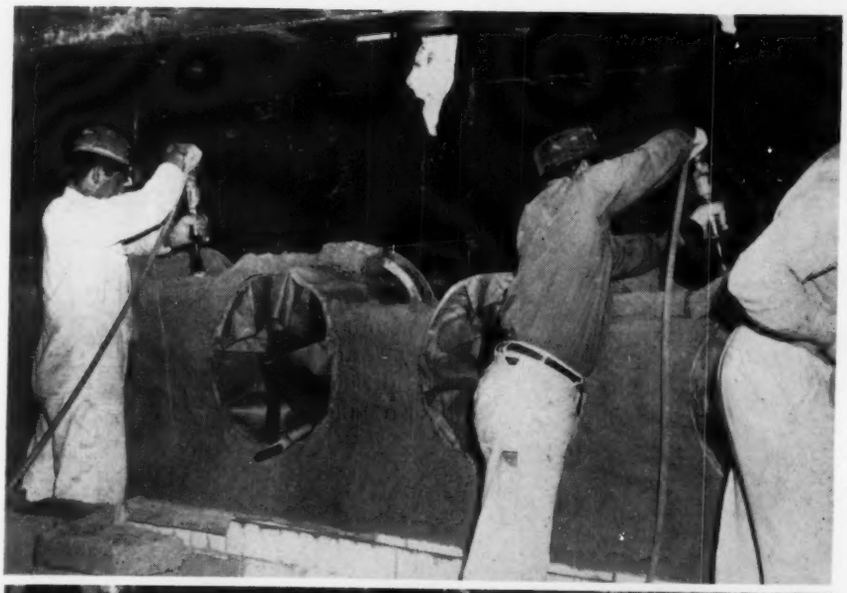
OHIO: Akron • Canton • Cincinnati • Cleveland • Columbus • Dayton • Elyria • Hamilton • Lima • Lockland • Mansfield • Toledo • Youngstown • Zanesville
INDIANA: Ft. Wayne • Indianapolis • Muncie • Terre Haute • **PENNSYLVANIA:** Erie • Johnstown • Philadelphia • Pittsburgh • York
WEST VIRGINIA: Charleston • Huntington • Parkersburg • Wheeling • **NEW JERSEY:** Camden
NEW YORK: Buffalo, Balanrol Corp. • **MARYLAND:** Baltimore • **DELAWARE:** Wilmington

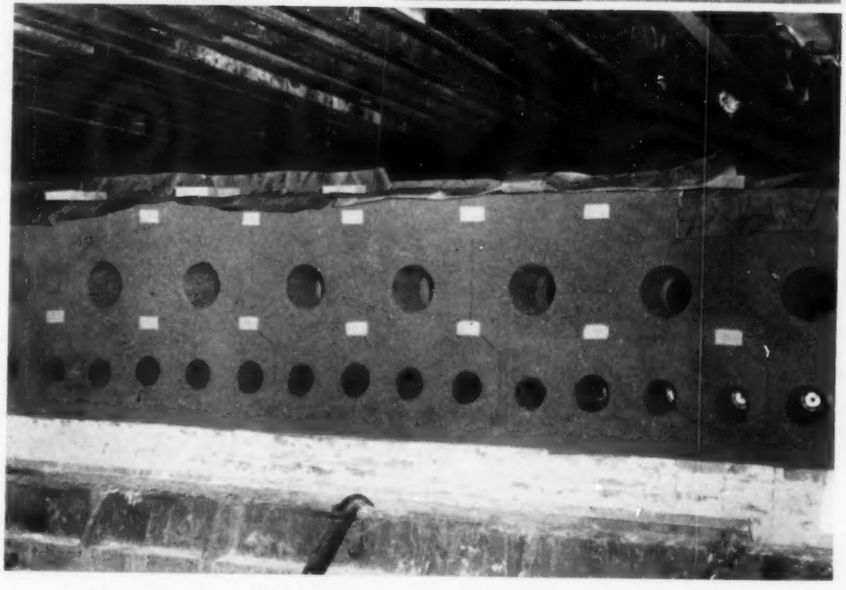
and

in the South →

DIXIE BEARINGS, INC.

FLORIDA: Jacksonville • **GEORGIA:** Atlanta • **KENTUCKY:** Louisville • **LOUISIANA:** Baton Rouge • New Orleans
N. CAROLINA: Charlotte • Greensboro • **S. CAROLINA:** Greenville • **TENNESSEE:** Chattanooga • Kingsport • Knoxville • Nashville





In December, 1957, Ramtite was installed in the upper heating zone and soak zone burner walls of three new Rust triple-fired slab reheating furnaces at Kaiser Steel Corp., Fontana, California.

Ramtite®

BURNER WALLS

first because they last . . . . . longer!

What happens when a well designed burner wall begins to spall and crack?

Fuel and furnace efficiency drop!

Burner ports lose their original contour!

And, improper flame shape causes impingement, damages stock and refractories!

But, not with Ramtite burner walls, first because they last . . . longer.

HERE'S WHY

Ramtite combines exceptional spall resistance with high refractoriness. And, experience has taught us not only *where* Ramtite can be used to best advantage, but *how* it should be installed. This know-how makes the difference.

Ramtite burner walls last, and maintain perfect port contour to deliver the performance the furnace designer intended, the performance you expect.

Check with your friends first, then write us.

The Ramtite Co. offers you a complete sales engineering service. Experienced men are always available to study your refractory problems and consult with your Engineering, Mason and Ceramic Departments about your specific needs.

The Ramtite Co.

DIV. OF THE S. OBERMAYER CO.

1813 South Rockwell Street Chicago 9, Illinois

©1958

BIG STEEL NEEDS BIG CRANES

Alliance engineers have incorporated the use of special alloy and USS T-1 steels in the construction of the biggest ladle crane yet—this outstanding 525-tonner to be installed at United States Steel's Fairless Works Division of United States Steel Corporation. Use of these special metals, where practical, results in reduction of wheel loads, and permits installation on existing runways now carrying 450-ton cranes. This keeping ahead of all facets of crane design-engineering has established Alliance as the leader in the big crane field. Why not talk to the Alliance engineers in Alliance or Miami? They'll help solve your material handling problems quickly and economically.

Alliance

THE ALLIANCE MACHINE COMPANY
Main Office: Alliance, Ohio
Branch Office: Miami, Florida

"Give us the Runway and we'll lift the World"

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION • COKE PUSHERS

Equipment News...

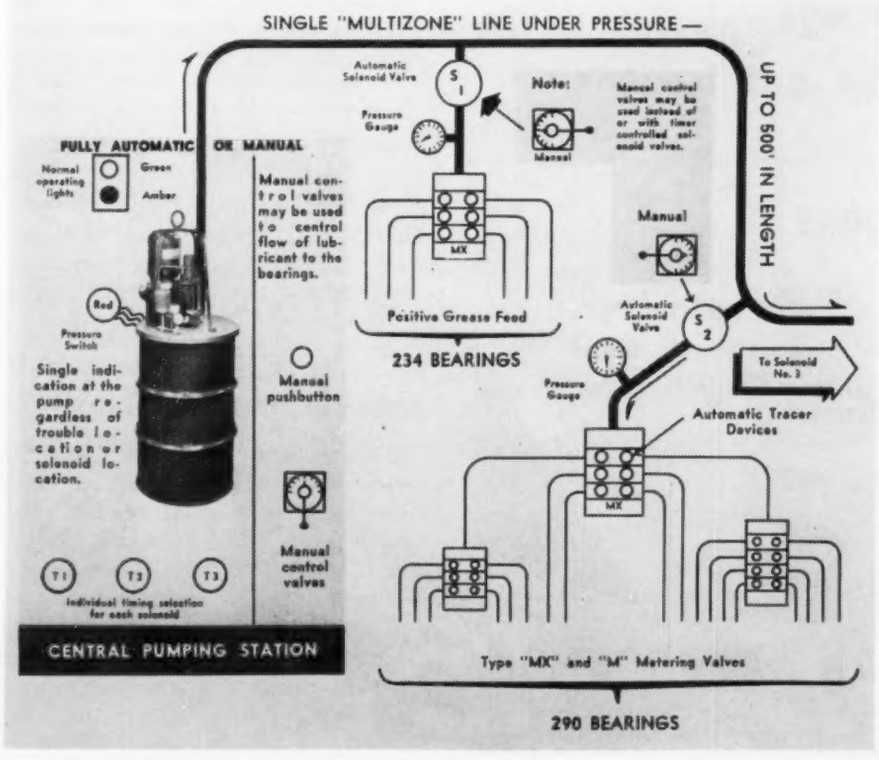
LUBRICATION SYSTEM

△ Trabon Engineering Corp., announces its new intermittent multizone lubrication system which enables a great number of bearings interspersed over a large area to be lubricated from one or more central stations.

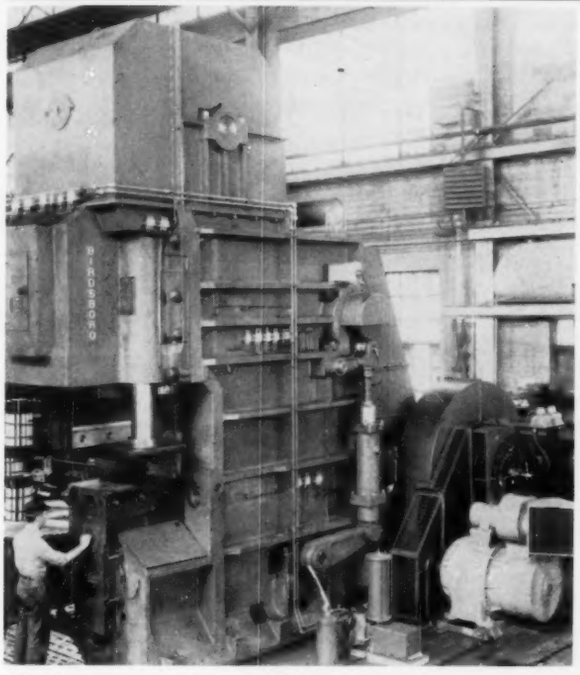
The system is ideal for steel mills, sintering plants and other applications where bearings are widespread and proper lubrication a problem.

An automatic or electric barrel pump with timing controls acts as the lubricant reservoir for the system. Hundreds of bearings receive measured amounts of lubricant at the precise time needed and there is a single indication at the central station and at each individual zone that all bearings have been satisfactorily lubricated. (Each zone can provide for 50–100 bearings.) The single indication feature is positive assurance that all bearings receive the lubricant they need.

The multizone is a single line system which may be up to 500 ft or more in length. Heart of the system is the Trabon metering valves which dispense exactly the amount of lubricant needed by the bearings. The system increases bearing life, lowers maintenance costs, power costs, and is sealproof and dirtproof. In addition the system handles oils and medium heavy greases.


SINGLE "MULTIZONE" LINE UNDER PRESSURE —
UP TO 500' IN LENGTH
Automatic Solenoid Valve
Note:
Manual control valves may be used instead of or with timer controlled solenoid valves.
Pressure Gauge
Manual
FULLY AUTOMATIC OR MANUAL
Normal operating lights
Green
Amber
Manual control valves may be used to control flow of lubricant to the bearings.
Red
Pressure Switch
Single indication at the pump regardless of trouble location or solenoid location.
Manual pushbutton
Positive Grease Feed
234 BEARINGS
Automatic Solenoid Valve
To Solenoid No. 3
Pressure Gauge
Automatic Tracer Devices
Manual control valves
Individual timing selection for each solenoid
CENTRAL PUMPING STATION
Type "MX" and "M" Metering Valves
290 BEARINGS

SHEAR CUTS BLOOMS-SLABS FREE FROM END HOOK



This 1000-ton up-and-down cut shear, largest machine of its type in this country, has been designed and built by Birdsboro Steel Foundry & Machine Co. for a leading steel producer. The shear will be used to cut hot steel blooms up to 16 in. square, and slabs up to 6½ x 42 in. Cutting is accomplished by the rising action of the bottom knife, hence there is no need for depressing tables or related equipment. A special hold-down device is integrally linked to the up-stroking bottom knife during the cutting stroke, holding the work firmly in the cutting plane. This results in blooms and slabs with square cut ends.

INGOT MOLD COATING

△ A new ingot mold coating known as Albi "MRX" has been in use by a major steel producer for some time, and is reported to have a number of advantages over preparation formerly used. It is manufactured by Albi Mfg. Co.

Primary advantage of this special preparation is said to be that it helps prevent hot metal from sticking to the walls of the ingot mold, whether from pouring or splatter. This reduces scabs, blisters, surface lamination and slivers.

As splatterings of the molten metal hit the sides of the mold, the coating swells and forms an insulating layer. During this swelling a decomposition of the elements in "MRX" takes place. The whole mass carbonizes. Gases formed inflate this carbonaceous mat, causing an insulating layer between the hot metal and the walls of the mold, thereby preventing the metal from freezing on to the mold so that the splattered globules stay in liqiud form and fall back into the main mass without congealing.

As the molten metal rises in the mold, the intumescent action of the

coating along with the release of nitrogen gas promotes a gentle rolling action at the walls of the mold. This tends to work the molten metal away from the walls of the mold, slightly degasifying the ingot walls as well as preventing any additives from reaching the mold walls or ingot surface. This action helps eliminate segregation at the ingot surface, thus reducing "streaks" in the finished steel product.

Improved ingot surface and longer mold life are also reported. If ingot molds are "fire cracked," the coating preparation tends to prevent molten metal from entering cracks or other imperfections in the mold surface.

The preparation is ready for use, is easy to apply, dries quickly, does not contaminate the steel and has a good shelf life with no waste. It produces no smoke, fume or odor, and leaves no residue either in the mold or on the ingot. Teeming is more efficient because the white coating permits the operator to see better into the mold.

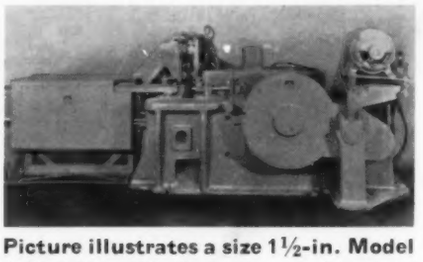
On large production runs of cold reduced steel sheets in one mill, rejections were reduced from 30 to 50 per cent. Based on these results a saving in excess of $3.00 per ton was gained at a cost of less than 12¢ per ton, including both the cost of the coating and application.

Ten gallons of the coating preparation will treat molds for 300 tons of ingots.

FORGING MACHINE

△ Development of a line of new automatic forging machines is announced by the Hill Acme Co. These upset-forging machines will be produced in the normal sizes of 1¼ in. to 5 in. for producing various products automatically.

The material is pre-cut to length, heated and fed into a receiving chute on the auto forging machine. These parts are then gaged, picked up by the fingers and passed progressively through the dies. While the material is being moved from pass to pass it can be rotated 90 deg to assure a uniform forging. Short parts are allowed to drop through the bottom opening of the machine and long parts are ejected rearward from the machine.



Picture illustrates a size 1½-in. Model XN automatic forging machine for producing up to ¾ in.-diam square or hex head bolts with a length up to 24 in. long at a rate of 60 bolts per min.

A finished upset forging is produced with every revolution of the automatic forger. This development does not limit the number of passes or the length of stock to be used in making a part.

CRANE LADLES

△ A new series of bottom discharge crane ladles for pouring large quantities of slag-free metal has been developed by the Industrial Equipment Co. The new Twin-Tower units feature a geared discharge mechanism specially engineered to minimize ladle space requirements and promote foundry safety and convenience.

The design provides 18 lever

SUPERIOR
CARBON
BRICK
FOR
◀ Blast furnace linings
◀ Blast furnace run-out troughs
◀ Cupola linings
◀ Steel pickling tanks

Standard sizes and shapes • Tested performances
Competent technical service • Superior chemical and metallurgical characteristics • Graphite brick also available.

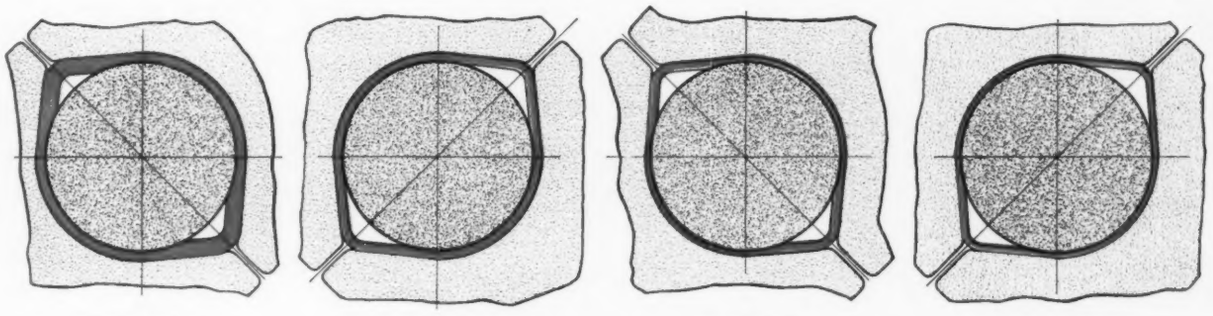
May we give you a quotation?

ELECTRODE GLC® DIVISION
GREAT LAKES CARBON CORPORATION
18 EAST 48TH STREET, NEW YORK 17, N.Y. • OFFICES IN PRINCIPAL CITIES

TIPS FROM A ROLL MAKER'S NOTEBOOK

MACKINTOSH-HEMPHILL DIVISION, E. W. BLISS COMPANY, Pittsburgh 3, Pennsylvania

Cast mill rolls • Johnston cinder pots • rotary tube straighteners • end-thrust bearings • heavy-duty lathes • steel and special alloy castings



STAND THREE STAND FOUR STAND FIVE STAND SIX

Severe service conditions at pass edges are shown graphically by these sectional diagrams of various stands of a nine-stand mandrel mill.

Solutions to some hole-rolling problems

Obviously, there is no single roll analysis to solve all seamless tube mill rolling problems. Nevertheless, in general, once the round has been pierced, the qualities needed in rolls for the later stands—whether the mill be a mandrel mill or a plug mill with reeling and sizing stands—are similar, varying only in degree.

Mandrel mills should get the best—Usually, the most severe operating conditions are to be found in mandrel mills. The rolls must provide high strength, uniform high hardness, resistance to slippage and freedom from scale pickup. The latter quality is especially important in this kind of mill, since the metal of the tube wall is being squeezed between the rolls and the traveling mandrel. We recommend *Midland Superalloy* nickel-chromium-molybdenum alloy steel rolls for this service. Their graphite-free composition and ability to be heat treated to high hardness levels makes them exceptionally resistant to spalling and fire cracking. Hence, they deliver pipe and tubing of top quality, providing long production runs between redressings.

The plug rolling mill process is easier on rolls—Plug mills (high mills), with their following reelers and sizers, place less severe demands on the rolls they use. The reeling stands spread the work over a fairly wide face, and the sizing stands are limited in the amount of reduction they can take by the tendency of the tube wall metal to upset. *Technigrain* or *Nironite AX* alloy iron rolls have the depth of hardness penetration and smoothness of surface needed to provide even wear throughout a complete plug mill set-up. In certain cases, *Technikrome* alloy steel rolls provide the additional strength sometimes needed in the high mill itself.

Whether or not your rolling facilities include seamless tube mills, you'll find that Mack-Hemp can offer you helpful, cost-saving advice on all matters of roll selection and use. Why not call or write us today?

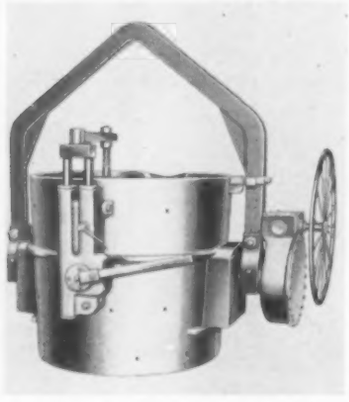
MACKINTOSH-HEMPHILL

You get more tonnage from the rolls with the Striped Red Wabblers

Division of E. W. BLISS COMPANY

Presses, Rolling Mills, Special Machinery

positions for adjusting the operating lever to proper height for safe, easy pouring. The lift column can be securely clamped at any desired height. The gear unit, oil tight and dust proof, operates in a continuous oil bath, with efficient oil seals to assure a leakproof assembly. The gear housing cover is gasketed and bolted to the rear of the unit for



trouble-free maintenance. The end of the cross arm accommodating the stopper rod is slotted to allow liberal adjustment.

The crane ladles are available in four models, and in 10,000 to 40,000 lb capacities.

WELDER CONTROL

△ Square D Co. has introduced a complete new line of nonsynchronous electronic combination welder controllers designed to give the performance required on high-speed production lines and the flexibility to meet changes in materials and designs.

Increased flexibility and greatly simplified maintenance are effected by functional breakdown of the control into individual panels for se-

quence timing, power supply, valve operation and contactor firing. The combination control with 600-frame contactor has provision for either 200- or 400-ampere QMB fusible disconnect switch, either 3B or 5B timer, either tube or relay control of the air valve and either tube or relay firing of the ignition contactor.

Provision is made for the plug-in addition of heat control, slope control, current regulator, forge delay, dual control functions and other special features.

FLEXIBLE COUPLINGS

△ A complete line of flexible couplings, now being offered in sizes to 4250 hp and over, by Lovejoy Flexible Coupling Co., features quick installation and easy alinement. Connection to driving and driven shafts can be made in minutes. Alinement is so simple that it can be accomplished with a straight edge. Gages are not required.

With bore sizes ranging to 9½ in., the couplings are especially constructed for the most rugged types of service. Bodies and jaws are machined electric steel or nodular cast iron. No complicated mechanisms or intricate parts are used. The load is entirely transmitted through compression of individual load cushions. This not only eliminates wear on the metal jaws, thus substantially increasing coupling life, but also permits reversal or advancing of cushions on nonreversing loads to double cushion life.

Once installed, the couplings require practically no maintenance. They do not require lubrication. All parts are plainly visible for spot inspection, including cushions. The latter can be removed at any time without disturbing driving or driven units.

PNEUMATIC RELAY

△ A pneumatic relay which solves equations continuously by combining two or more pneumatic signals in varying, predetermined proportions is now being manufactured by Bailey Meter Co.

The new relay multiplies or divides one pneumatic signal representing a measured variable by some predetermined function of a second variable. Standard unit also

How to measure

Now is the time to take a long, hard look

A continuous furnace is more than just a brick-lined structure built to heat a material; it is a processing tool.

Like all processing tools, it must be evaluated on an overall basis. Fuel consumption and efficiency may be completely outweighed by many more-important economic factors centering around your workpiece, your total production program, and your work force.

Your evaluation may well prove that an investment now in Selas continuous heat processing will bring immediate returns in reduced costs and improved product quality.

To help you take this long, hard look at your heat processing equipment or requirements, Selas offers these 15 evaluation factors:

- **Material handling**
- **Product value**
- **Material saving**
- **Fuel efficiency**
- **Automatic operation**
- **Temperature control**
- **Labor requirements**
- **Work in process**
- **Product quality**
- **Equipment flexibility**
- **Maintenance**
- **Production requirements**
- **Process coordination**
- **Floor space**
- **Human element**

The factual report on the facing page tells how a steel mill took this long, hard look at its bloom reheating. Every evaluation factor proved significant: one factor alone represented savings which equalled the cost of the entire Selas furnace line in 1½ months!

SELAS

the real cost of continuous heat processing

. . . here's how one SELAS installation stands up under that "long, hard look!"

Conventional practice of reheating blooms had been to remove them from the rolling process, charge them into batch-type reheating furnaces, soak them for 60 to 90 minutes. Blooms were then taken from the furnace, placed back onto the rolling mill table for final rolling.

At least 2 handlings of steel by mechanical manipulator were involved. It is generally agreed that picking up hot steel, transporting it 100-150 feet and setting it down, costs $2 per ton.

Material Handling

Selas continuous heat processing has eliminated both handlings . . . saved enough to pay for the heat processing equipment in 1½ months!

Product Value

The value of the material passing through this furnace line in only 26 hours equals the cost of the entire heat processing installation!

Material Saving

Because reheating time is 3 minutes instead of the conventional 60 to 90 minutes at 2250°F, less scale is formed. This amounts to a saving of 3 tons of steel per hour—enough to pay for the continuous furnace line in only 5½ months!

Fuel Efficiency

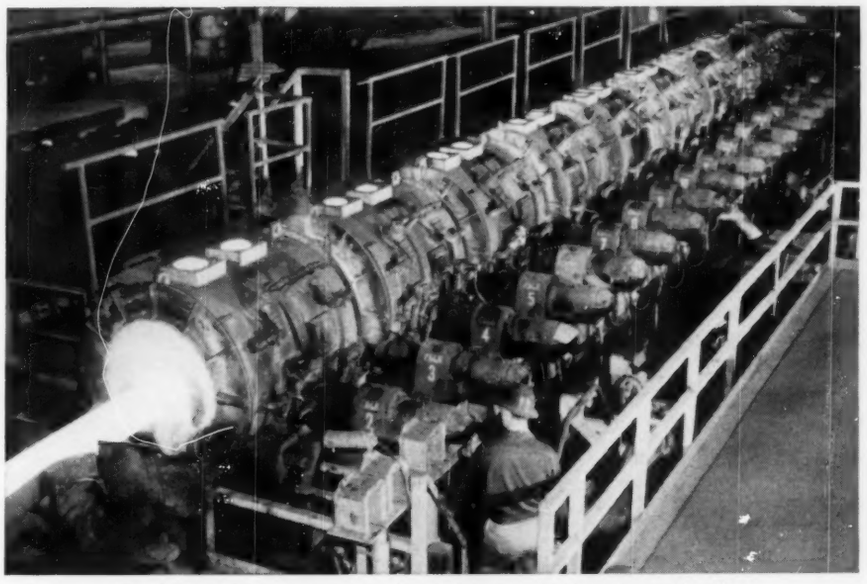
Fuel efficiency is not of major consequence because the total fuel cost is less than 0.6% of product value. Fuel efficiency could be increased through recuperation. Even if fuel efficiency could be increased by 50%, however, the cost of this additional equipment — plus higher maintenance — would add more to production cost than the 0.3% saved.

Automatic Operation

The furnace line accepts blooms at the charge-end whenever space is available in the furnace. Or, if no bloom is on the conveyor the furnaces automatically go on low temperature setting. Blooms, at optimum rolling temperature, are automatically delivered whenever required by the rail mill.

Temperature Control

Fast response of the Gradiation® furnaces permits accurate automatic control of bloom temperature. Uniform heating by radiant gas-fired Duradiant® burners produces optimum rolling temperature throughout every bloom.



Continuous Selas furnace line, located between a blooming mill and a rail mill, reheats blooms "on the fly," at rates up to 198 tons per hour.

Labor Requirements

None! Routine supervisory inspection of recording equipment is the total human contribution required.

Work in Process

Only 9½ tons of steel (maximum) need be in process to meet even the most widely varying production requirements. The previous method required 195 tons.

Product Quality

Reproducible metallurgical uniformity is achieved within each bloom and from bloom to bloom.

Equipment Flexibility

Furnace line heats blooms from 8 inches square to 11 inches square in cross-section, 8 to 22 feet long, weighing from 1744 to 9050 pounds each.

Maintenance

Simple, minimum. A stand-by barrel is quickly inserted into the line whenever major overhaul is necessary.

In 23 months of continuous operation, seven barrel furnaces have been re-lined, at a cost of only ⅔ cents per ton of reheated blooms. This is less than 0.007% of the value of product passing through the furnace line, and amounts to but 1.03% of the total original equipment cost.

Production Requirements

The furnace line can handle up to 198 tons per hour according to fluctuating demands of the rail mill.

Process Coordination

This continuous Selas line is an integral part of the roll conveyor between the blooming mill and the rail mill.

Floor Space

Valuable floor space was saved through Selas fast heating. This entire furnace line occupies only 63 x 11 feet.

Human Element

Automatic control and operation completely eliminate variables in product quality due to the human element.

* * *

For case histories covering other steel mill heat processing operations, as well as heat treating, heating for hot working and brazing, send for reprint "An Economic Appraisal of Continuous Heat Processing." Address Dept. 16, Selas Corporation of America, Dresher, Pa.

Gradiation and Duradiant are registered trade names of Selas Corporation of America.

SELAS CORPORATION OF AMERICA DRESHER, PENNSYLVANIA

Heat and Fluid Processing Engineers

DEVELOPMENT • DESIGN • CONSTRUCTION

RED CIRCLE
Rolls
ALLOY-CHILLED
Hyde Park
RAMS
for all types of
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Hyde Park Rams are available in Chilled or Alloy Iron.
Furnished in hardness range to meet your specification . . . ground to your required size.
On your next replacement of Rams—or for new equipment—consult us. Our engineers will be glad to assist you.
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FOUNDRY & MACHINE CO.
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ROLLS
ROLLING MILL MACHINERY
GRAY IRON CASTINGS

adds and subtracts pneumatic signals and provides proportional control action.

Users in process plants will find it well suited to the ratioing of two flows in multi-element control systems, and to pressure-temperature

compensation of liquid or gas flow measurement.

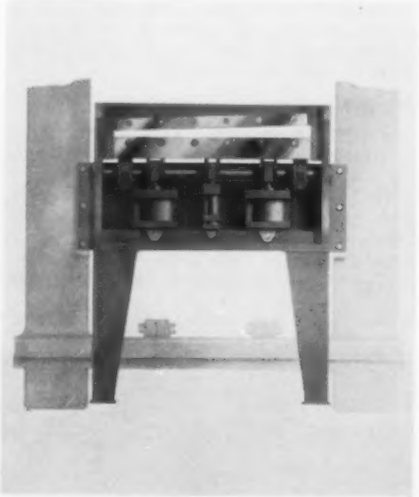
The relay uses standard SAMA ranges of 3–15 psig and 3–27 psig. Approximate size: 8½ x 11 x 9 in. deep. Function-generating cam is easily shaped on the job.

MILL-MOUNTED SHEARS

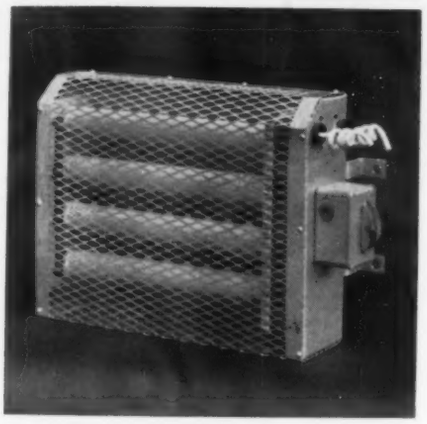
Δ A new series of air-operated, mill-mounted shears for cutting fishtails from leading and trailing ends of strip and sheet has been developed by Curry Air Shear Corp.

Extremely compact in size and light in weight, these shears are bolted directly to existing or new mill housings. Sheet or strip passes from the mill rolls directly between the knife blades of the shears.

The shears are made in models to cut 24-in. to 84-in. wide strip and



HEAVY DUTY HEATERS



Designed for industrial service this heavy duty Guyan Machinery Co. heater can withstand the hard abuse so often necessary in normal operation of heavier equipment. Engineered to dissipate the required wattage for your individual needs this heater features low original cost, low maintenance cost, dependable service and long life.

sheet. With air-operation there is no possibility of overloading. Also, according to the manufacturer, the air-operation makes possible minimum floor space requirement, minimum maintenance and lower investment.

HOLLOW SHAFT MOTORS

Δ Availability of its all-weather climatized vertical hollow shaft motor in ratings up to 2000 hp is announced by The Louis Allis Co. This motor is designed for indoor and unprotected outdoor service in industrial pumping applications.

Motor design offers greater compactness for space savings and handling ease, and incorporates the most recent advances in insulating materials. These materials provide optimum resistance to moisture and chemical contaminants, and have high mechanical strength for added life.

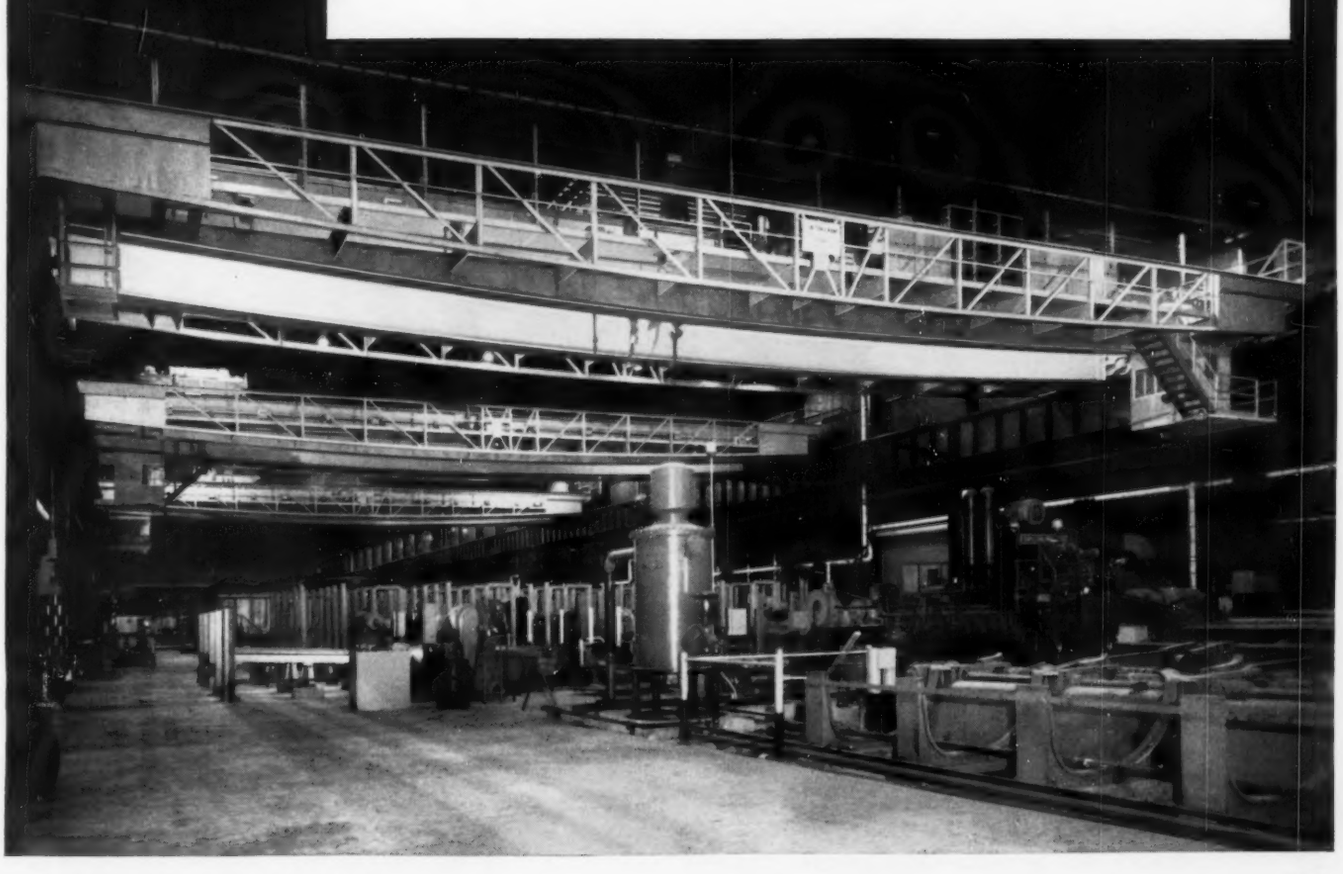
A maximum of two-high angular bearings are used in the motor to prevent excessive wear and reduced thrust capacity. Water-cooled Kingsbury type thrust bearings are utilized in extra-high thrust applications. For bearing protection the motor has an oil-metering system, sealed bearing chambers and Alnico magnet drain plugs that collect foreign ferrous particles in the oil. Design allows bearing inspection

AMERICA'S LARGEST STEEL MILLS USE BROWNING CRANES

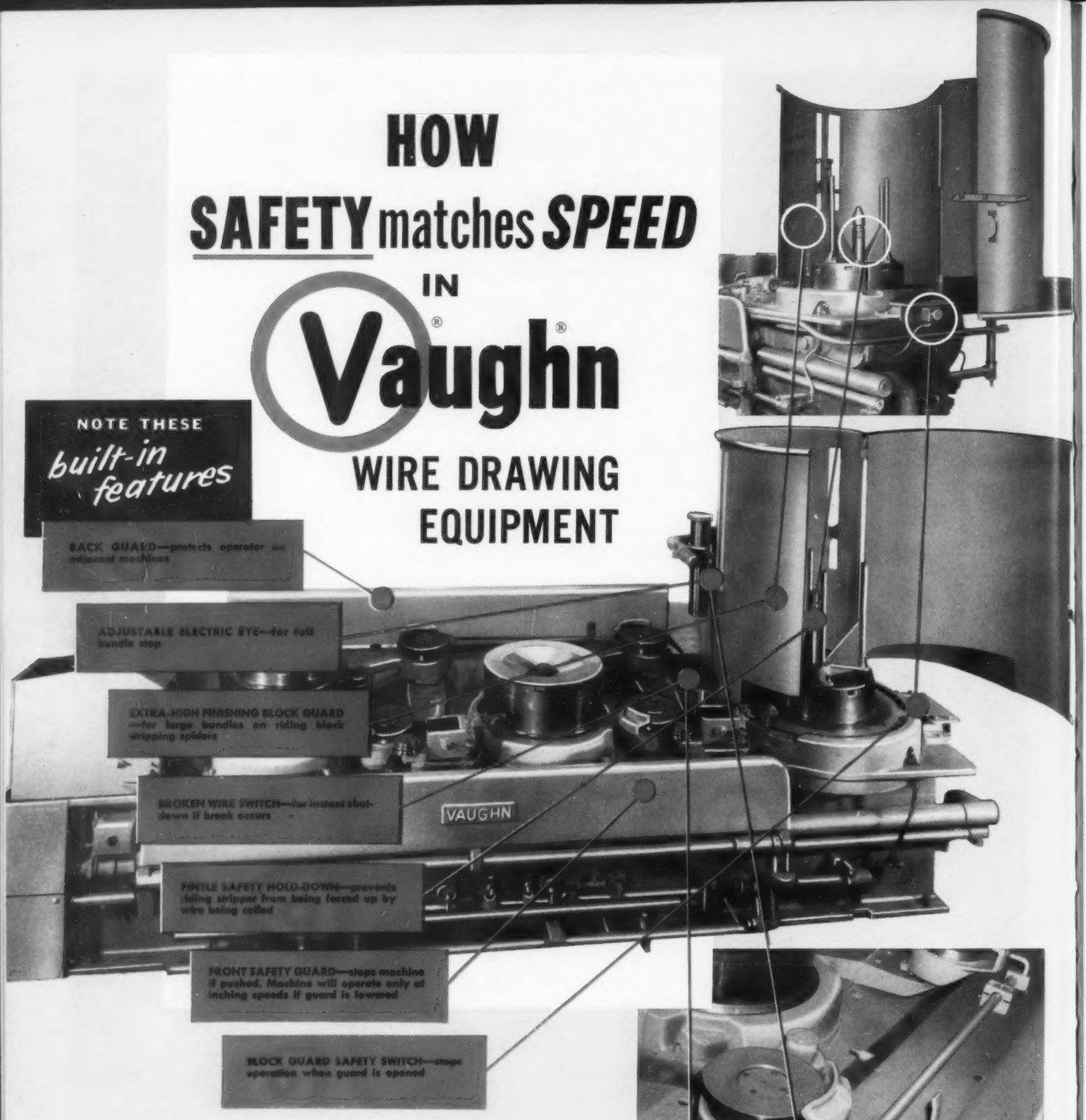
Built to A. I. S. E.
Specifications or Your Own

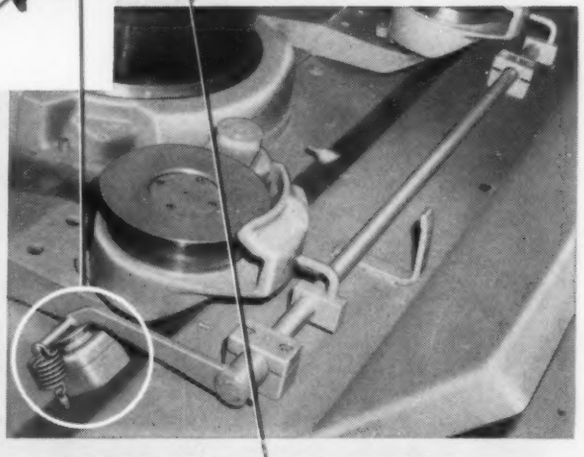
For years, Victor R. Browning & Co. has devoted major time and study to the building of heavy duty mill cranes. The finest materials and workmanship go into the construction of these cranes. All shafts are of the highest quality alloy steel. All bearings are calculated with a proper life factor as required by the A. I. S. E. We will design to suit your special requirements or build to your specifications . . . Victor R. Browning & Co. also makes a complete line of trolleys which can be adapted to existing bridges.

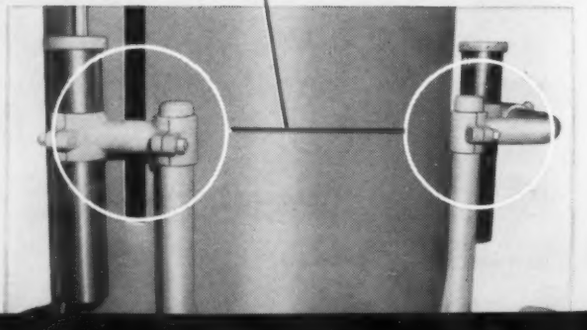
VICTOR R. BROWNING & COMPANY, INC.
WILLOUGHBY (CLEVELAND), OHIO



HOW SAFETY matches SPEED IN Vaughn WIRE DRAWING EQUIPMENT


NOTE THESE built-in features
BACK GUARD—protects operator on adjacent machines
ADJUSTABLE ELECTRIC EYE—for full bundle stop
EXTRA-HIGH FINISHING BLOCK GUARD—for large bundles on riding block stripping spiders
BROKEN WIRE SWITCH—for instant shut-down if break occurs
PINTLE SAFETY HOLD-DOWN—prevents riding stripper from being forced up by wire being coiled
FRONT SAFETY GUARD—stops machine if pushed. Machine will operate only at inching speeds if guard is lowered
BLOCK GUARD SAFETY SWITCH—stops operation when guard is opened
VAUGHN





SAFETY for men and equipment is engineered thoroughly into Vaughn Wire Drawing Machinery—in every type, in every model. The high operating speeds of modern Vaughn machines are *safe* speeds because of this engineering. Our Motoblox, Motoblocs, Ringblox and other equipment are designed to match *productivity with protection* over the widest range. Let us detail our many safety developments, at your convenience.

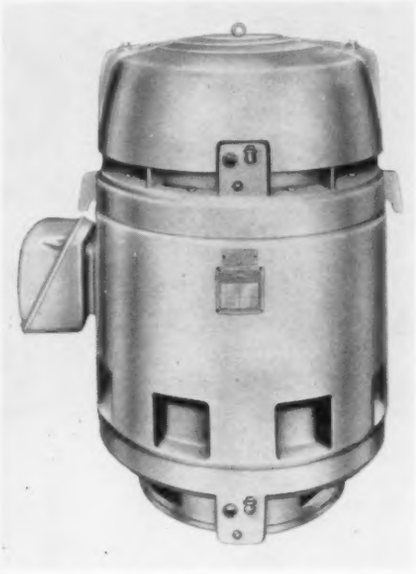
"Quick on the Draw!"

The VAUGHN MACHINERY COMPANY
CUYAHOGA FALLS, OHIO

COMPLETE COLD DRAWING EQUIPMENT—Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

of even the largest motor in five minutes.

Because of high motor efficiency a minimum of cooling air is required. This permits low cooling air velocity and prevents dust and moisture from being drawn into the motor by the air stream. Ninety



degree bends in the air flow system prohibit the entrance of snow and rain.

Self-release couplings prevent unscrewing of the shafting in case of accidental motor reversal. Optional features include nonreverse ratchet, part winding or increment start connections, bearing and winding temperature detectors or thermoguards, space heaters, and snow covers.

Book Reviews

"ASME Handbook—Metals Engineering-Processes," edited by Roger W. Bolz, and sponsored by the Metals Engineering Handbook Board of the American Society of Mechanical Engineers, has recently been published by the McGraw-Hill Book Co., 327 W. 41st St., New York 36, N. Y. The book contains 448 pages, 7¼ x 9⅞ in., is cloth bound and sells for $13.50. This handbook contains detailed data on the various processes by which metals are converted into finished products, it is composed of 45 sections covering such areas as the heat-treatment of steel, casting, hot and cold working, powder metallurgy, welding, machining and electroforming. For each of the manufacturing methods, there is a compilation of the basic physical characteristics to be considered and the general advantages and limitations usually encountered. Concise, parallel data concerning the suitability of various metals for each process, and the natural tolerances on size and surface finish obtainable, assist in evolving designs that meet all functional requirements consistent with economical production techniques. Illustrated with hundreds of charts, illustrations, and other aids, the book covers scores of production methods: die casting, hot forming, bending, pressworking, cold heading, thread rolling, metal spinning, flame cutting, cleaning, buffing, and much more. Book is final volume of 4-volume ASME Handbook.

"Agricola on Metals" by Bern Dibner has recently been published by Burndy Library, Norwalk, Conn. The book contains 128 pages, 8¼ x 10½, is bound in heavy paper, and sells for $2.50. This book is a distillation of "De Re Metallica" written by Georgius Agricola in Latin, and translated by former president Herbert C. Hoover and Mrs. Lou Henry Hoover. The historic

(*Please turn to page 198*)

for intense concentration of heat...

The BLOOM HTR BURNER

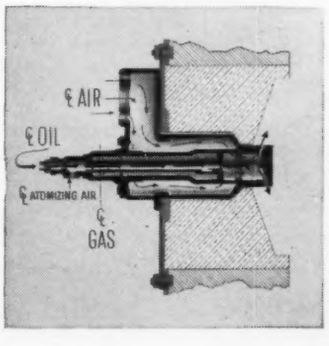
The Bloom HTR Burner provides identical operation on either gas or oil.

This burner enables the engineer to design a heat pattern with excellent results, because it has the unique characteristic of providing localized high heat release with low forward velocity. The burner can be located to fire directly at the material without flame impingement. Roof firing is easily accomplished and provides uniform hearth temperature.

This burner has been very successful in its application to tube upset furnaces; continuous strip annealing, coating, and pre-heating lines; high speed billet heating furnaces; and batch-type forge furnaces.

The Bloom High Thermal Release Burner with its sturdy construction is ideal for applications requiring speed and precision heating.

PATENT PENDING

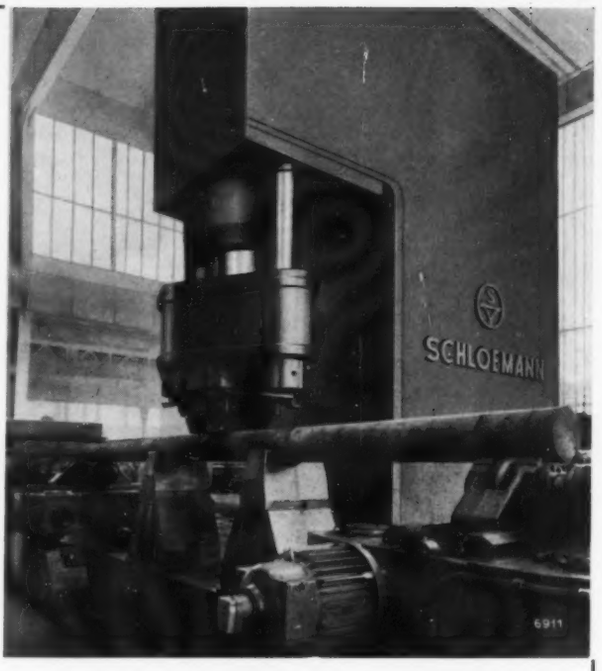


BLOOM ENGINEERING CO., INC.
837 W. North Avenue Pittsburgh 33, Pa.

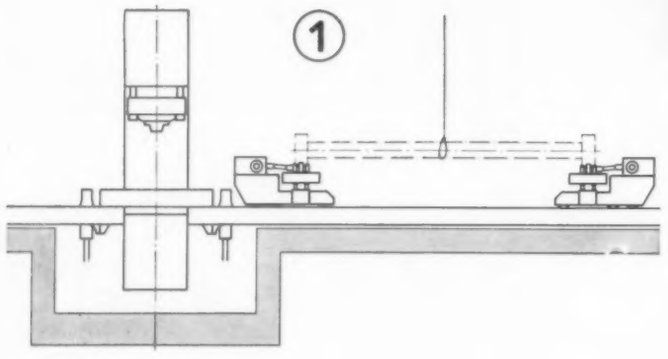
SCHLOEMANN
ROLLING MILLS • HAMMERS • PRESSES

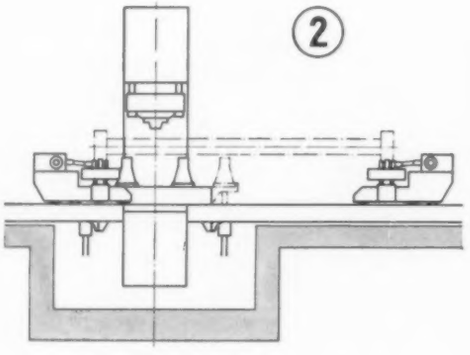
Oil hydraulic gag press

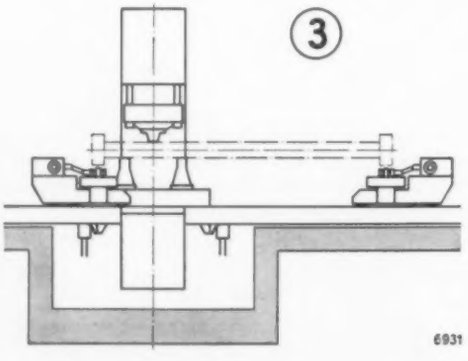
A modern gag press quickly pays for its cost. In the first place, the forging press, which uses much more energy, is relieved of straightening work and more time can therefore be given to forging; furthermore, machining allowance is saved through better straightened forgings. Based on the experience of many years, SCHLOEMANN has developed a new type of gag press.



This oil-hydraulic 1,100 ton gag press is operated in conjunction with a 2750 ton forging press and several heavy hammers.







Technical data

Power		1,100 tons
Operating pressure		4,500 PSI
Pump Motor		48 HP
Forgings	max. length	66 ft.
	max. shaft dia	20 in.
	max. flange dia	40 in.

Features and advantages

- Easy placing, shifting and lifting of workpieces outside the press, and quick lifting, turning (action at both ends, 4 speed steps) and shifting under the press by electric straightening carriages.
- Flanged shafts can be handled easily, also, as the straightening saddles can be lowered hydraulically.
- Small space requirements (no lift table). The press can also be set up in an adjacent hall without cranes between the furnaces.
- Modern welded construction. The oil pump and oil container, as well as the controls, are arranged in the upper part of the housing, thus being protected and at the same time easily accessible.
- Sensitive control of all movements from a desk. An electric interlock prevents damage by faulty operation.

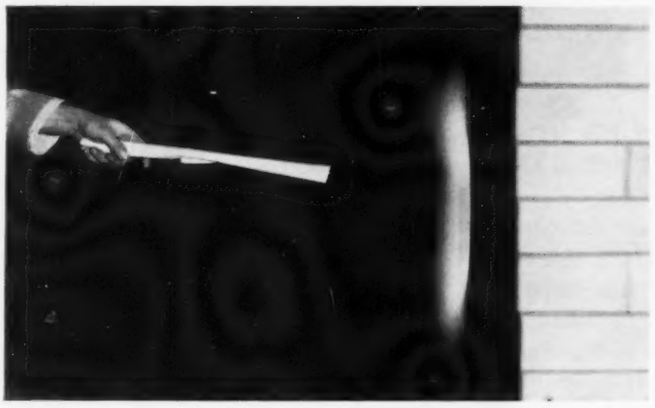
① Placing a shaft on the carriages which can be moved individually or jointly. The saddles are shown in their lowest position.

② The shaft has been moved under the press by the carriages and has been turned into the straightening position. The saddles are in the operating position.

③ The shaft has been placed on the saddles by a slight lowering of the rotating rollers. Straightening begins. (After lifting the rotating rollers and lowering the saddles, the straightened shaft is moved out to left or right.)

FELLER ENGINEERING CO., 1161 EMPIRE BUILDING, PITTSBURGH 22, PA.

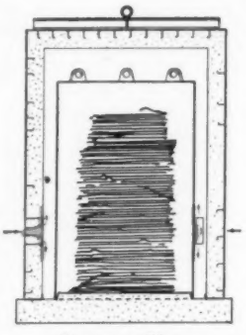
North American



FLAT FLAME BURNERS Provide Lots of Heat with No Hot Spots

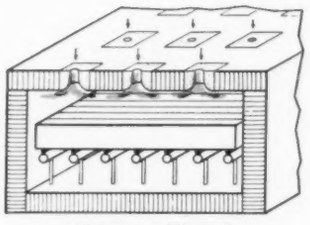
Place the Flat Flame Burner close to the work without risk of hot spots or flame impingement — as graphically illustrated by the rolled paper in the photo. This burner delivers as much heat as any burner of comparable size, but heating will be uniform over a large area.

Applications That Profit Through Use of Flat Flame Burners



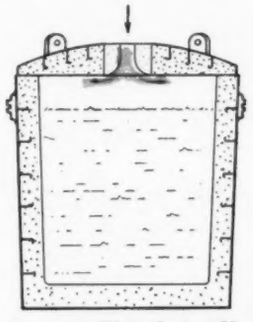
Cover Type Annealing Furnaces

Simple direct firing with a few Flat Flame Burners without baffle plates gives good heat distribution that results in longer cover life.



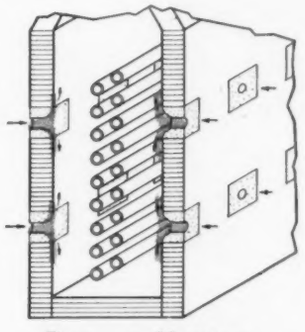
Direct Fired Billet Heaters

Lower the roof & costs with Flat Flame Firing. Get plenty of even heat with no flame impingement. (Burners can be adjusted for flame impingement when desirable.)



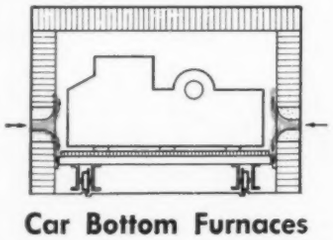
Cover Fired Ladles

Comparatively cheap gas firing gives good temperature uniformity without flame impingement — even in a compact cover usually associated with electric heat.



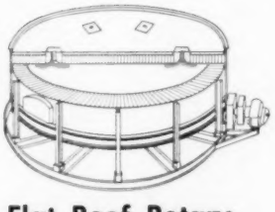
Process Heaters

With Flat Flame Firing, use fewer burners and place them closer to the tubes. You get more even heat absorption and have a more compact, less costly furnace.



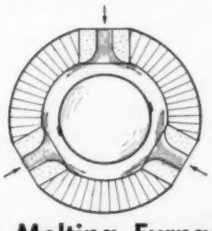
Car Bottom Furnaces

Flat Flame Burners spread heat evenly over wide areas without creating hot spots in front of the burners. Mount the burners closer to the car, permitting construction of a narrower furnace.



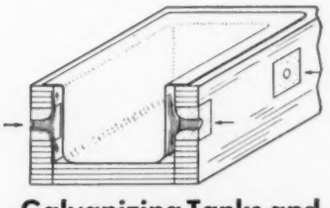
Flat Roof Rotary Heat Treat Furnaces

Modernize furnaces with Flat Flame Burners in the roof for better capacity and temperature distribution. Design furnaces with lower roofs.



Pot Melting Furnaces

Firing Flat Flame Burner directly is equivalent to firing tangentially both right and left. This results in simpler brickwork, smaller furnace O.D., better heating in the pot.



Galvanizing Tanks and Salt Bath Furnaces

Flat Flame Burners spread heat uniformly over wide areas. Tanks will have longer life since hot spots are eliminated.

For engineering information consult your nearby N. A. office or write for Bulletin 4832 ▼

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The North American Manufacturing Co.

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The Pangborn Engineer in your area will be glad to take off his coat and go to work on *your* cleaning problem at no obligation. For full details on Rotoblast Barrels, write to: PANGBORN CORP., 4400 Pangborn Blvd., Hagerstown, Md.
Manufacturers of Blast Cleaning & Dust Control Equipment.

Pangborn Rotoblast Barrels are available in 1½, 3, 6, 12, 18, 20, 32, 72 and 102 cubic foot sizes.

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For application to soaking pits, heating, and other types of metallurgical furnaces.
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Book Reviews

(*Continued from page 193*)

work "De Re Metallica" is one of the most significant single books in the history of technology, an encyclopedic, richly illustrated record of a highly developed industrial culture that flourished a good 200 years ahead of the beginnings of what is usually called "the industrial revolution." Its influence is indicated by four Latin, three German and one Italian editions. It first appeared in English in 1912 after five years of research and translation by the Hoovers. "Agricola on Metals" reproduces over 70 selected illustrations from an original edition, and besides underlining the greatness of Agricola's own contributions, pays tribute to the remarkable scholarship of its translators. The highlights of this modern work, a crystallization of the 16th century mining and metallurgical classic, may suggest the broad range of modern arts and sciences that appear in embryo in Agricola. His work made notable contributions, not only to engineering in the special fields he treats, but also to technological progress in other industries, to the social science of management, and to the foundations of such natural sciences as geology and chemistry.

"Product Directory of the Refractories Industry in the United States, 1958 Edition" has recently been published by The Refractories Institute, First National Bank Building, Pittsburgh 22, Pa. This volume lists 2700 brands of refractories produced by 185 refractory manufacturers, representing almost 100 per cent coverage of the industry; it is cross indexed, for ready reference, by companies, plant locations, product divisions and brand names. Copies may be obtained at $3.00 each from the Institute.

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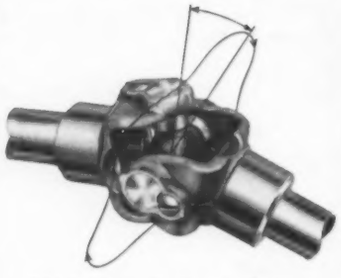

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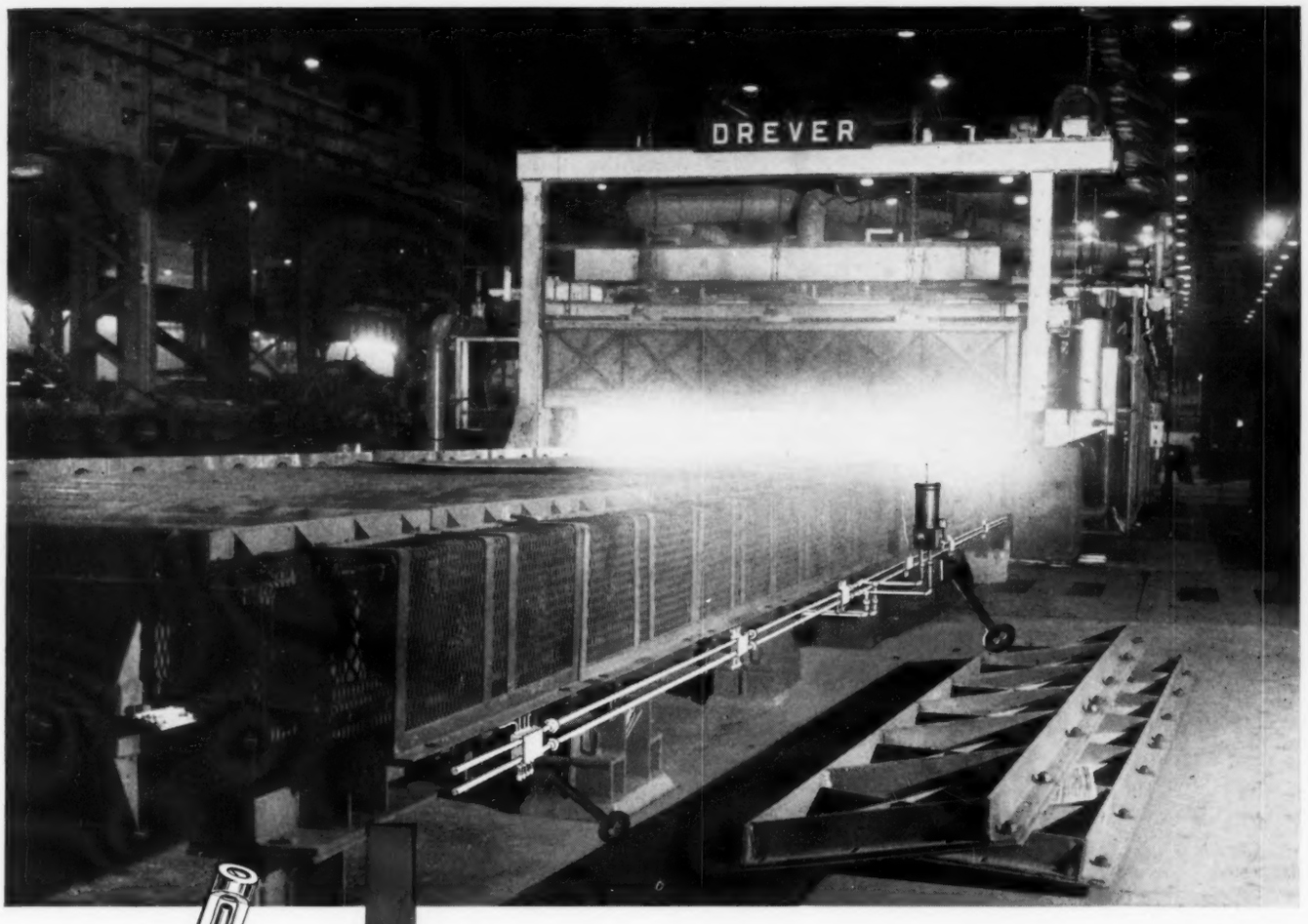

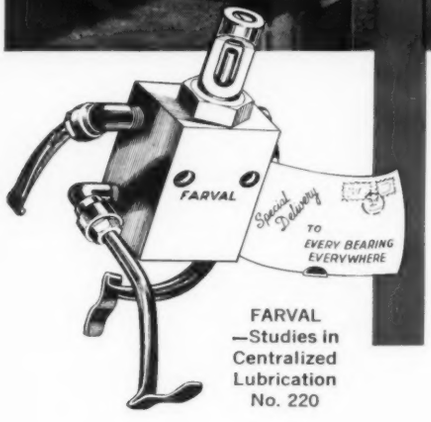

FARVAL
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No. 220

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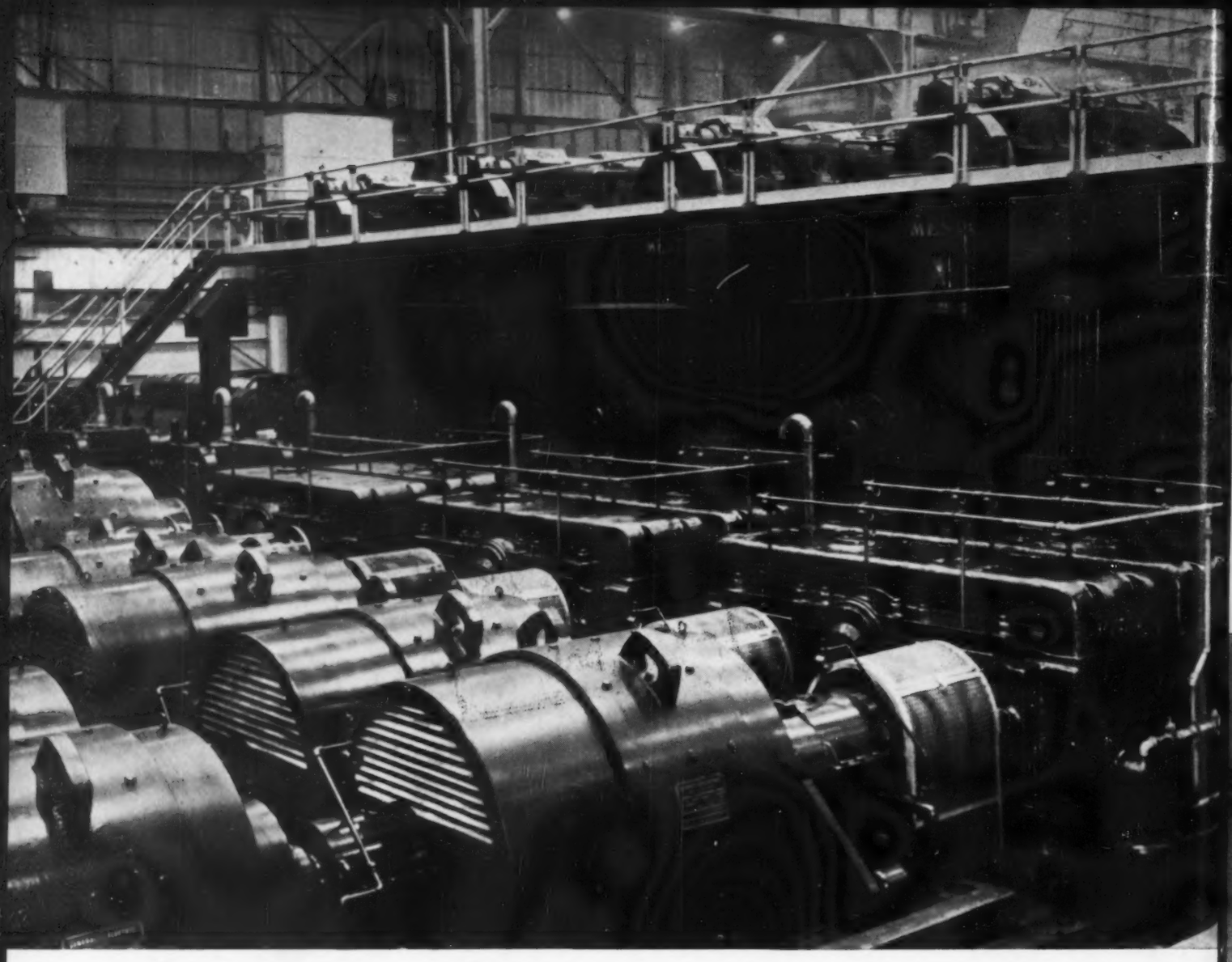

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